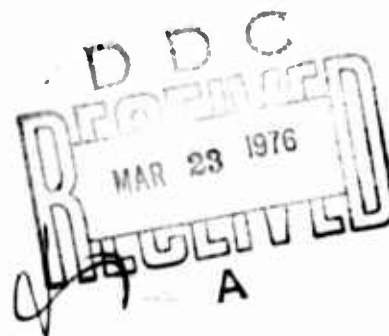FG.

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TRAINING INDIVIDUALS IN ARMY UNITS: COMPARATIVE EFFECTIVENESS OF SELECTED TEC LESSONS AND CONVENTIONAL METHODS

Claramae S. Knerr, Ronald G. Downey,
and John J. Kessler

INDIVIDUAL TRAINING AND SKILL EVALUATION TECHNICAL AREA

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Research Institute for the Behavioral and Social Sciences

December 1975

U. S. ARMY RESEARCH INSTITUTE

FOR THE BEHAVIORAL AND SOCIAL SCIENCES

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The Army has developed a system of self-paced audiovisual lessons--the Training Extension Course (TEC)--designed to upgrade individual skills and to help commanders conduct individual proficiency training. This report compares the effectiveness of TEC training with that of conventional Army classroom instruction, evaluating both against a baseline level of performance.→

Five TEC lesson categories (courses) were used, four from infantry training and one from field artillery training. Five hundred eligible

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20.   soldiers were selected by their units for training at two Army posts and from a National Guard division. Each soldier was assigned to one course. Participants were randomly divided into three equal groups. The first group received the TEC lessons; the second group received conventional instruction (CI) on the same topics; and the third, baseline (BL), group received no special training during the research.

A hands-on performance test for each course was given all participants after the training to measure the comparative effectiveness of each training method.

CONVENTIONAL INSTRUCTION (CI)
BASE LINE (BL)

The TEC-trained groups in general scored highest in the performance tests, followed by the CI groups; BL groups performed least well. The TEC groups performed consistently better than the BL group. The TEC groups performed better than either the CI or BL groups on tests that emphasized reasoning and information. TEC and CI groups performed equally well, and better than the BL groups, on performance tests that emphasized skill with equipment and psychomotor activities.

In the Active Army, performance test scores in the TEC groups were equally high for persons with low and high general mental ability, as measured by the GT aptitude area score. In contrast, performance test scores for CI groups were generally lower for persons with lower general mental ability.

TEC lessons consistently improved soldier performance regardless of the soldiers' level of mental ability, suggesting TEC would be particularly useful for training of mixed-aptitude personnel. Where skill or practice with equipment is involved, however, conventional instruction is equally effective. Results are expected to generalize to other situations, as findings were basically the same in the three different sites of this research.

TRAINING INDIVIDUALS IN ARMY UNITS: COMPARATIVE EFFECTIVENESS OF SELECTED TEC LESSONS AND CONVENTIONAL METHODS

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FOREWORD

A primary mission of the Individual Training and Performance Evaluation Technical Area of the Army Research Institute for the Behavioral and Social Sciences (ARI) is to support the Army's Enlisted Personnel Management System (EPMS) by developing and providing suitable performance-oriented training and testing for individuals. Under EPMS, training of individuals beyond initial entry-level courses is given increased emphasis; an important component of individual training is that provided at the unit or company level. The Army has developed a system of self-paced audiovisual lessons--the Training Extension Course(TEC)--designed to upgrade individual skills and to help commanders conduct this individual proficiency training. The TEC program is now being implemented throughout the Active Army, Reserve Components, and senior ROTC units.

This Research Report compares the effectiveness of TEC training with that of conventional Army classroom instruction. A companion report, ARI Research Problem Review 75-3, compares the estimated costs of the two training programs, thus providing a cost-effectiveness view.

ARI research in this area, conducted under Army Project 2Q763731A733, FY 75 Work Program, is responsive to special requirements from the Army Training and Doctrine Command (TRADOC) and the Army Combat Arms Training Board (CATB). Military support for the research was provided by several sources: LTC Donald E. Biesenbach and the U.S. Army Infantry Human Resources Unit at Fort Benning, Georgia under LTC Robert Matheson contributed substantially. Troop support was supplied by the 100th Division (Training) USAR; 4th Infantry Division (Mechanized), Fort Carson, Colorado; 9th Infantry Division and 1st Signal Group, Fort Lewis, Washington; and 38th National Guard.

J. E. UHLANER
Technical Director

TRAINING INDIVIDUALS IN ARMY UNITS: COMPARATIVE EFFECTIVENESS OF SELECTED TEC LESSONS AND CONVENTIONAL METHODS

BRIEF

Requirement:

To compare effectiveness of Training Extension Course (TEC) training and conventional instruction, evaluating both against a baseline level of performance.

Procedure:

Five TEC lesson categories (courses) were used: (1) Hand Grenades, (2) Light Antitank Weapon (LAW), (3) M16A1 Rifle, (4) 81mm Mortar Fire Direction Computer (Mortar FDC) from infantry training, and (5) Surveyed Firing Charts from field artillery training.

Five hundred soldiers who would normally receive training in each category were selected by their units at two Army posts and from a National Guard division. Each soldier was assigned to one course. In the Active Army, participants were trained and tested in all five courses; National Guardsmen were trained and tested in the four infantry courses.

For each course, participants were randomly divided into three equal groups. The first group received the TEC lessons, in which a pretest and a posttest are given with each individualized lesson. The second group received conventional instruction (CI) on the same topics, preceded by a pretest compiled from the separate TEC pretests and followed by the compilation as posttest. The third, baseline (BL) group took the CI pretest with the CI group as a measure of common knowledge and background, then returned to normal duties.

A hands-on performance test for each category was given all participants after the training to measure the comparative effectiveness of each training method.

Findings:

The TEC-trained groups in general scored highest in the performance tests, followed by the CI groups; BL groups performed least well. The TEC groups performed consistently better than the BL groups. The TEC groups performed better than either the CI and BL groups on tests that emphasized reasoning and information (Hand Grenades, Surveyed Firing Charts, and Mortar FDC). TEC and CI groups performed equally well, and better than the BL groups, on performance tests that emphasized skill with equipment and psychomotor activities (LAW and M16A1 Rifle).

In the Active Army, performance test scores in the TEC groups were equally high for persons with low and high general mental ability, as measured by the GT aptitude area score. In contrast, performance test scores for CI groups were generally lower for persons with lower general mental ability.

Utilization of Findings:

TEC lessons consistently improved soldier performance regardless of the soldiers' level of mental ability, suggesting TEC would be particularly useful for training of mixed-aptitude personnel. Where skill or practice with equipment is involved, however, conventional instruction is equally effective.

Results are expected to generalize to other situations, as findings were basically the same in the three different sites of this research.

TRAINING INDIVIDUALS IN ARMY UNITS: COMPARATIVE EFFECTIVENESS OF
SELECTED TEC LESSONS AND CONVENTIONAL METHODS

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FIGURES

TRAINING INDIVIDUALS IN ARMY UNITS: COMPARATIVE EFFECTIVENESS OF SELECTED TEC LESSONS AND CONVENTIONAL METHODS

The decentralization of training management to battalion level and below emphasized the need for training materials within Army units. Materials for training individual soldiers in job and Military Occupational Specialty (MOS) proficiency are required as well as materials for team training. In response to this need, the Training Extension Course (TEC) system was designed under the auspices of the U.S. Army Combat Arms Training Board (USACATB). The TEC system supplies instructional materials developed from expertise in the Army service schools for training in the unit environment.

The TEC system has undergone several iterations since it began. In the initial form, called TEC I, lessons were presented in combined sound and slide format. The U.S. Army Infantry School in conjunction with USACATB prepared 56 lessons on 11B MOS skills. Before TEC was extended to other MOS, a study of systems engineering of training for eight combat MOS was performed: two MOS from the branches of Infantry (11B and 11C), Armor (11D and 11E), Field Artillery (13A/B and 13E), and Air Defense (16P and 16R).[1] In the job analysis, tasks were identified on levels of specificity from tasks common to all eight MOS at the broadest baseline to tasks unique to a single MOS or skill level. The systems engineering and results were subsequently used to produce performance objectives for training and testing materials.

The current system, TEC II, includes audio-visual, audio only, and programmed text lessons, projection and audio hardware; explanatory literature; and accompanying material for practical exercises. Hundreds of TEC II lessons are being developed for the eight combat MOS named above. Additionally, TEC III lessons are being prepared for soldiers in five critical duty positions in combat battalions (e.g., unit clerk). Expansion of the TEC system to other service schools is being carried out as TEC IV. Given the projected scope of the TEC system and the costs associated with its development and implementation, the cost-effectiveness of TEC is important.

OBJECTIVES

The objective of this research was to determine the effectiveness of selected TEC lessons in terms of job-related performance. A parallel

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[1] McCluskey, Michael R., Jacobs, T. O., and Cleary, Fred K. Systems engineering of training for eight combat arms MOS. (Tech. Rep. 74-12). Alexandria, Va.: Human Resources Research Organization, June 1974.

project analyzed the cost of TEC training, so that these two projects taken together indicate the cost effectiveness of TEC.[2]

TEC contains many system components including lesson development, field utilization, maintenance, and user attitudes. The aspects of usage rates, maintenance, and attitudes are addressed in concurrent research.[3] Assessment on these dimensions was not repeated in the present project. The effects of other aspects, such as optimal utilization practices under natural field conditions, must await further implementation of the system. Limited availability of time and completed lessons further restricted the scope of the research.

In accordance with AR 37-13,[4] which establishes the paradigm for conducting cost-effectiveness studies, the TEC lessons were evaluated in relation to an alternative means of attaining the same training objectives. The alternative selected as a basis of comparison was instruction planned and conducted by the unit training staff utilizing unit instructors. Training by instructors is an alternative that characteristically is employed in units to conduct training in topics similar to those contained in the TEC lessons.

The objective of this research effort, then, was to compare the effectiveness of selected TEC training with that of training carried on by unit instructors. Both training methods were evaluated against a baseline level of performance. Effectiveness was measured by performance tests relevant to the lesson content but not specifically designed for TEC.

PROCEDURES

The research design divided 500 soldiers into three experimental groups. In one group soldiers received individual training on audio-visual TEC lessons (TEC). In another group soldiers were trained by conventional group instruction (CI). The third group received no

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[2] Temkin, Sanford, Connolly, J. A., Marvin, M. D., Valdes, A. L., and Caviness, J. A. A cost assessment of Army training alternatives. ARI Research Problem Review 75-3. August 1975.

[3] McCluskey, Michael R., and Tripp, James M. An evaluation of the utilization, maintenance, and perceived benefits of the Training Extension Course (TEC) (Tech. Rep. 75-18). Alexandria, Va.: Human Resources Research Organization, June 1975.

[4] Department of the Army. Army Regulation 37-13, Economic Evaluation and Program Evaluation of Resource Management, 6 April 1973.

special training during the course of the research and was used as an
index of baseline performance (BL). The research design is summarized
in Table 1.

Table 1

ADMINISTRATION OF TRAINING AND TESTS
(N = 500)

Group	N	Pretest	Special Training	Posttest	Performance Test
TEC	167	Yes	Yes	Yes	Yes
Conventional Instruction (CI)	163	Yes	Yes	Yes	Yes
Baseline (BL)	170	Yes	No	No	Yes

In the TEC system, lessons are accompanied by printed Lesson Admin-
istrative Instructions (LAI) containing lesson objectives, prerequisites,
lists of practice materials, and a criterion test. The LAI tests, based
on items from the lessons, usually require written responses although a
few require actual performance. The LAI recommend that the soldiers take
the LAI test before studying the lesson. If they pass (achieve a
minimum percent correct as stated in the LAI), they may omit the lesson.
If they fail the pretest, they are advised to study the lesson and retake
the test. For the present research, however, soldiers took the LAI test
both before and after the lessons in order to provide pretest and post-
test scores on all of the lessons. The soldiers studied the lessons
regardless of their pretest scores.

In the Conventional Instruction group (CI) the written LAI tests
covering all lessons pertaining to one topic were administered in a
single consolidated booklet before the training. The group was then
taught by an instructor selected for that purpose by the unit. Following
presentation of all the training material, the consolidated LAI test was
administered again.

The BL group received the LAI tests only one time, as the pretest
in the single booklet of consolidated tests administered to the CI
soldiers. The BL group did not receive training relevant to the topics
in the research, but rather continued in normal unit duties during the
course of the research.

Each soldier participated in only one experimental group in one topic. Troop support was provided by the 4th Infantry Division (Mechanized), Fort Carson, Colorado; 9th Infantry Division and 1st Signal Group, Fort Lewis, Washington; and 38th National Guard. Personnel of the 100th Division (Training), USAR, Test Section, administered the performance tests.

The selected lesson categories (courses) of Hand Grenades, Light Antitank Weapon (LAW), M16A1 Rifle, 81mm Mortar Fire Direction Computer (Mortar FDC), and Surveyed Firing Charts were taught in both the Active Army and National Guard, except the Surveyed Firing Charts lessons which were evaluated only in the Active Army.

Each lesson category was analyzed separately, and separate analyses were conducted for each Active Army division and for the National Guard. The results for the two Active Army divisions were combined if the same pattern of results occurred in both of them. The statistical analyses for the Active Army and National Guard were not combined, because the training conditions and abilities of Active Army and National Guard men are not similar. For example, the National Guard groups were given the performance tests on the day after training while the Active Army groups had a weekend to an entire week between the training and performance testing.

RESULTS

The performance test scores among the experimental groups are compared first, followed by comparisons within each course. Analyses of the LAI pretests, GT scores, and other background variables indicated that the experimental groups did not differ significantly before training, except in the Mortar FDC course for the Active Army and in the M16A1 Rifle course for the National Guard. However, results of analyses performed on performance test scores adjusted for the initial differences produced the same conclusions as results from the unadjusted scores. Differences in performance scores, therefore, do reflect differential training effectiveness.

Differences in Performance Test Scores

In general, the TEC trained men had the highest performance test scores, followed by the CI trained men, with the BL men performing least well. Performance after TEC training was consistently higher than the BL performance; in contrast, performance after CI training was more variable. In some courses the CI group resembled the TEC group, while in others it was closer to the BL group. The percentages of correct performance scores for the three groups in each course are shown in Figure 1 for the Active Army and Figure 2 for the National Guard.

Figure 1. Comparison of mean percent correct on performance tests in each lesson category for the three experimental groups from the Active Army.

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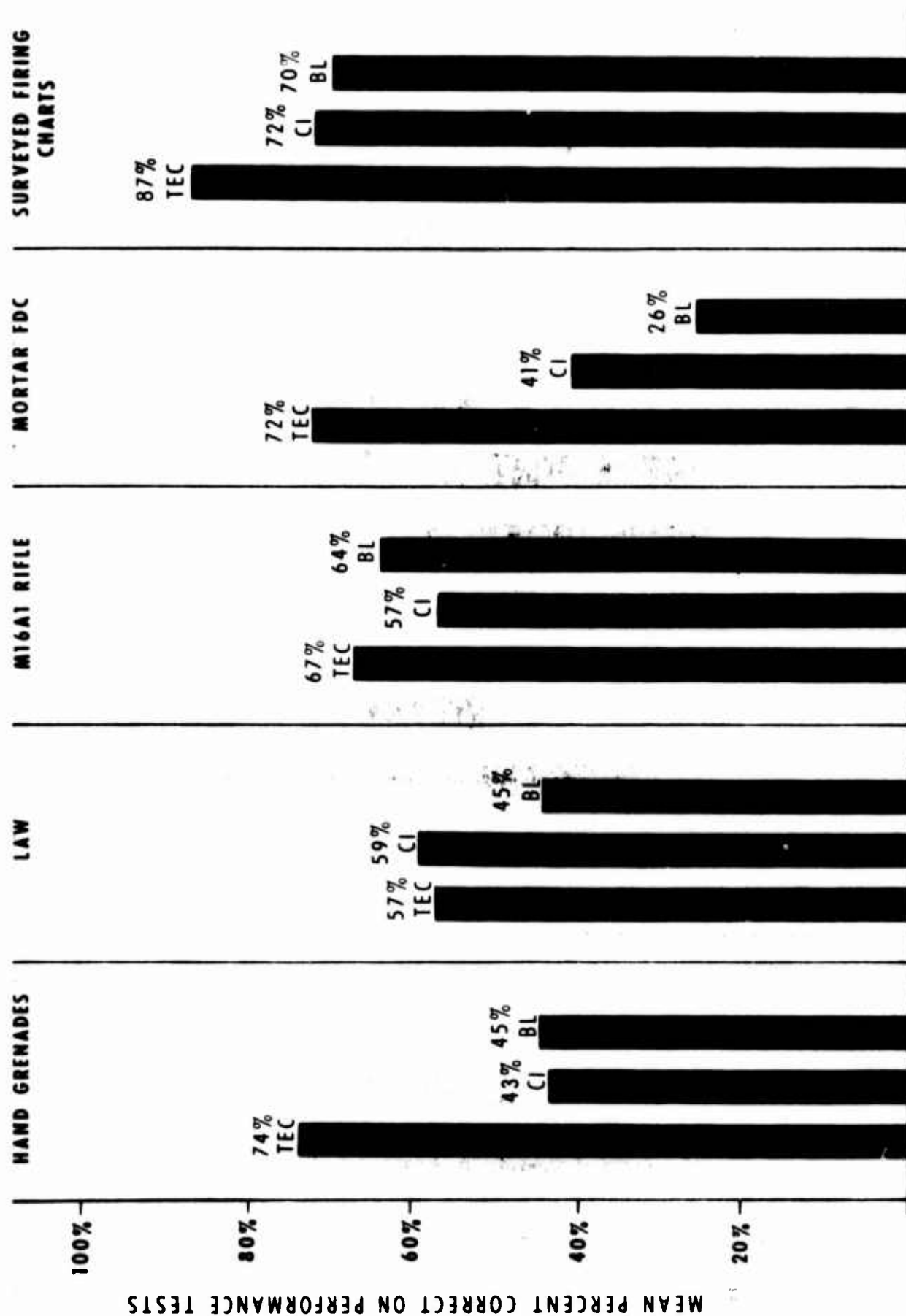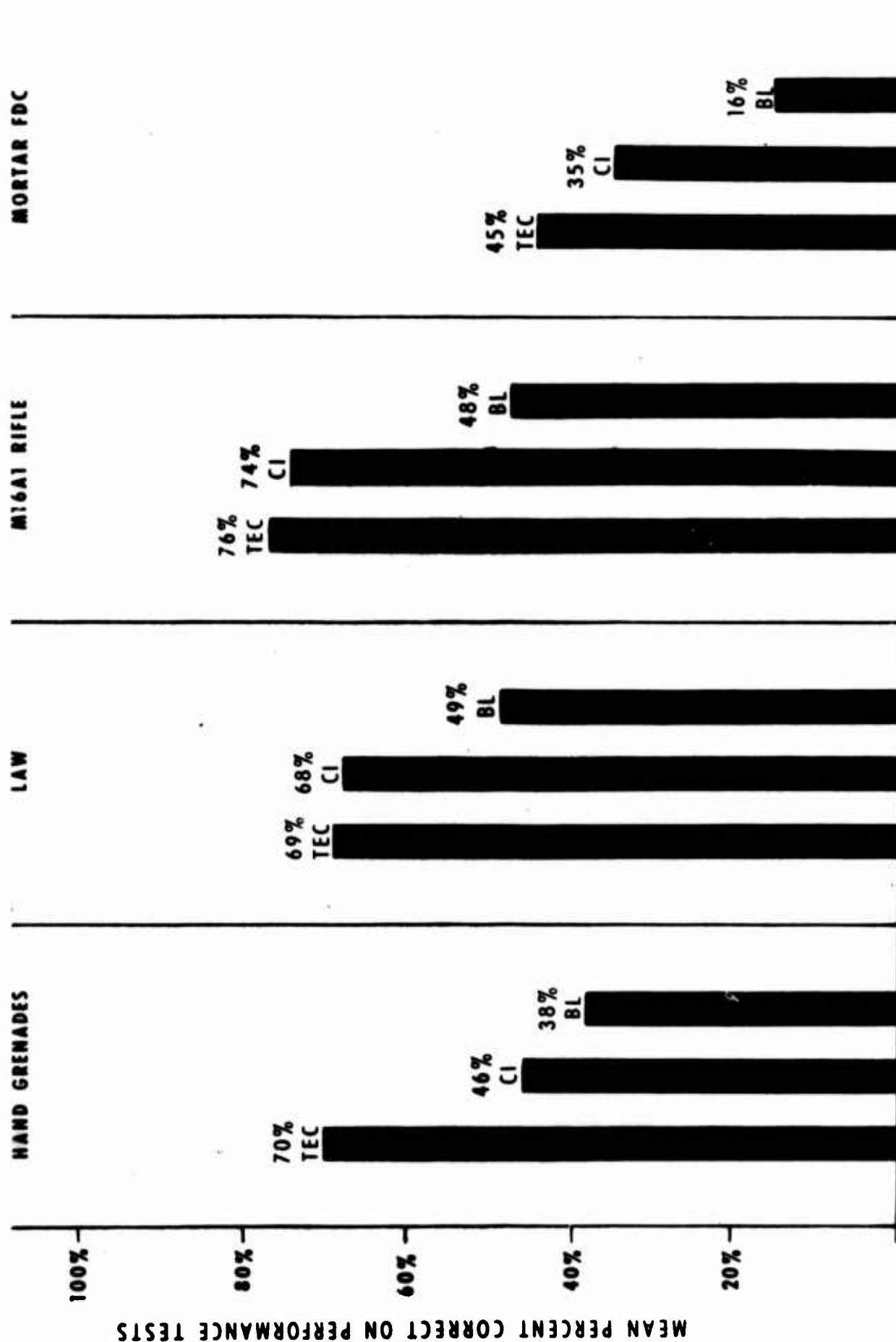
Figure 2. Comparison of mean percent correct on performance tests in each lesson category for the three experimental groups from the National Guard.

In the Hand Grenades, Mortar FDC, and Surveyed Firing Charts courses the TEC group scored higher than the other two groups. These results were replicated in both the Active Army and National Guard for the Hand Grenade and Mortar FDC courses; the Surveyed Firing Charts course was evaluated only in the Active Army. For the Mortar FDC, the TEC group was highest, the BL group was lowest, and the CI group was in the middle. For the Hand Grenades and Surveyed Firing Charts, TEC was significantly higher than the other two groups, while CI was about the same as BL.

In both the National Guard and the Active Army, both groups trained on the LAW scored significantly higher than the BL group. The same pattern of results emerged for the M16A1 Rifle training in the National Guard. The M16A1 Rifle analysis in the Active Army was the only case where the TEC group was not reliably higher than the BL group. At one of the Active Army posts, however, difficulties had been encountered in supplying practice equipment for the soldiers to use during TEC training. The lack of equipment may have adversely influenced motivation and learning of the TEC soldiers at that post. At the other post, the TEC group had higher performance test scores than the other two groups, but the difference was not significant. Given the irregularities in the M16A1 Rifle TEC training, the Active Army results should be discounted. In the National Guard, where the training proceeded normally, the TEC and CI groups are higher than the BL group. These National Guard results are interpreted as more accurate estimates of the TEC and CI training effectiveness than the Active Army results.

In summary, the TEC and CI groups were about equal in performance and higher than the BL group in the LAW and M16A1 Rifle courses. The performance tests for the LAW and M16A1 Rifle emphasized psychomotor, mechanical, or physical skills in comparison to the other courses. On these tasks both TEC and unit instructors performed well in classroom training. The effectiveness of concurrent field training or range practice was not assessed.

In contrast to the LAW and M16A1 Rifle tests, the performance tests for the Hand Grenades, Mortar FDC, and Surveyed Firing Chart courses were predominantly cognitive. The particular Hand Grenade skills that were trained and tested included identification, selection, and maintenance of the grenades. These skills are more cognitive than the grenade throwing skills trained on the grenade range and evaluated in such tests as the Expert Infantryman Badge Test, which were neither trained nor tested in the present research. TEC lessons were more effective than conventional instruction in teaching the cognitive background information about hand grenades to the soldiers.

The content of the Mortar FDC and Surveyed Firing Chart courses is inherently cognitive, involving arithmetic reasoning and verbal skills. The TEC lessons were superior to conventional instruction in producing higher levels of performance by guiding the men through practical exercises on the intricate procedures.

In the Army and elsewhere, an important question concerns the effectiveness of training methods for individuals of low general mental ability. Optimal training approaches have been shown repeatedly to vary with the ability level of the trainees; that is, an interaction between ability and training approach is a frequent finding.

In the present research, the soldiers' General Technical (GT) aptitude area scores were obtained so that the impact of the training (TEC vs conventional unit instruction) could be examined in relation to the soldiers' ability levels. The GT aptitude area tests are composed of vocabulary items and arithmetic reasoning problems, and are administered during induction.

The GT scores in the National Guard samples tended to be higher than in the Active Army (Table 2). To develop an index of the GT levels the percentage of soldiers who had GT scores of 100 or less was determined. In the Active Army, none of the men in the field artillery sample for Surveyed Firing Charts had GT scores less than 100. Since this course was not tested in the National Guard, it was not included in the comparison. Considering all other lesson categories, 47% of the Active Army sample had GT scores of 100 or less compared to 24% of the National Guard. The Mortar FDC course sample had higher GT levels than other courses in the Active Army and thus more nearly resembled the National Guard sample. When the Mortar FDC course is omitted, the percentage of men with GT scores of 100 or lower was 51% for the Active Army and 25% for the National Guard.

The GT scores were similar for the experimental groups within each lesson category and within each population (Active Army and National Guard) with two exceptions: in the Active Army, the Mortar FDC CI group had a lower GT mean than the TEC and BL groups; in the National Guard, the M16A1 Rifle TEC group had a lower GT mean than the CI and BL groups. These exceptions were not believed to detract from the generality of the overall means in Table 2.

The correlation coefficient is the statistical technique used to show the effectiveness of training methods for individuals with differing levels of general mental ability. The magnitude of a correlation coefficient shows the degree of linear relationship between two measures. The values of the coefficient range from zero, which means there is no linear relationship between the measures, to 1.0, which means that the two measures are perfectly related or that one score can be perfectly predicted from the other. Another way of interpreting correlation coefficients is in terms of differences between average scores. Specifically, in the correlation between GT and performance test scores, a low correlational value near zero indicates that the average performance test score for persons with low GT scores is the same as the average performance test score for persons with high GT scores. A high correlation, close to 1.0, means that persons with low GT scores have low performance test scores and persons with high GT scores have high performance test scores.

Table 2

MEAN GT SCORES OF ACTIVE ARMY AND NATIONAL GUARD
SAMPLE GROUPS, BY LESSON CATEGORY

Lesson Category	Active Army (N = 285)			National Guard (N = 215)		
	Mean GT Score	Standard Deviation	N	Mean GT Score	Standard Deviation	N
Hand Grenades	104.10	16.66	48	107.32	14.61	59
LAW	100.76	15.06	53	110.56	13.99	59
M16A1 Rifle	101.10	13.98	74	114.44	11.29	43
Mortar FDC	110.37	16.22	51	113.83	20.14	54
Surveyed Firing Charts *	116.19	10.84	59	—	—	—

* Not administered in the National Guard

Correlations between GT and performance test scores are presented in Table 3 for the Active Army and Table 4 for the National Guard. Examination of the correlations for the Active Army show a distinctive pattern for the TEC groups as opposed to the CI and BL groups. In the TEC group, the correlations between performance test score and GT were all close to zero: they range from -.13 to .06, and the median correlation was .02. The TEC training had virtually eliminated the effect of GT on the performance test scores. On the other hand, the correlations between performance test scores and GT in the CI groups ranged from .11 to .61 with a median correlation of .27. In the BL group the correlations were similar to those in the CI group, ranging from .24 to .71 with a median of .43. Thus, the whole distribution of correlations in the TEC group was lower than for the other experimental groups.

The most important comparison is between the two groups that received training during the current research: TEC and CI. In the Active Army, the performance test scores were correlated with GT for the CI training group but not for the TEC group. TEC training was as good as or better than CI training, as indicated by the average performance test scores for the training groups. The low correlations and high performance scores for the TEC groups indicate that TEC was effective for soldiers with both high and low GT scores. In contrast, CI training was effective for soldiers with high GT scores but not for those with low GT scores.

Table 3

CORRELATIONS BETWEEN PERFORMANCE TEST SCORES AND GT SCORES,
BY LESSON CATEGORY AND ACTIVE ARMY EXPERIMENTAL GROUP

Lesson Category	Experimental Group		
	TEC	CI	BL
Hand Grenades	-.02	.61*	.24
LAW	.06	.54*	.44*
M16A1 Rifle	.02	.24	.43*
Mortar FDC	-.13	.27	.71*
Surveyed Firing Charts	.02	.11	.27

* Significantly higher than zero; p < .05

Table 4

CORRELATIONS BETWEEN PERFORMANCE TEST SCORES AND GT SCORES,
BY LESSON CATEGORY AND NATIONAL GUARD EXPERIMENTAL GROUP

Lesson Category	Experimental Group		
	TEC	CI	BL
Hand Grenades	.58*	.31	.36
LAW	.13	.15	.18
M16A1 Rifle	.27	.37	-.01
Mortar FDC	.26	.49*	.31

* Significantly higher than zero; p < .05

This pattern did not occur in the National Guard correlations between GT and performance test scores. The ranges of correlation values for the three experimental training groups are: TEC, .13 to .58; CI, .15 to .49; and BL, -.01 to .36. Given the small proportion of soldiers with low GT scores, the differential training effectiveness for soldiers with low general mental ability did not occur in the National Guard.

In summary, there is some evidence for an interaction between general mental ability and training approach in the Active Army. The present study does not provide conclusive evidence since it was not designed to investigate this interaction by drawing samples of different GT levels. It does indicate two points. First, evidence for the interaction is sufficient to warrant further research in order to enhance training of low ability soldiers. Second, TEC was effective in training the low ability soldiers in the Active Army.

CONCLUSIONS

The TEC trained groups were consistently superior on the performance tests in comparison to the BL groups and equal to or better than the CI groups.

Performance of the CI groups was more variable than that of the TEC groups. Training by unit instructors may vary in quality from place to place and time to time. In contrast, structured training programs as provided by TEC should produce more uniform instruction. The results of this research support both the variability of conventional group instruction and the uniformity of TEC instruction.

TEC was as effective for soldiers with low general mental ability, as measured by the GT aptitude area, as for soldiers with high general mental ability. In the Active Army, training by unit instructors was less effective for soldiers with low general mental ability than for soldiers with high ability. In the National Guard, the relative effects of training by unit instructors or by TEC for persons with low general mental ability was not determined due to the low number of low ability soldiers.

TEC groups performed better than the Baseline and CI groups on tasks that emphasized reasoning and information. The TEC and CI groups performed equally well, better than the Baseline groups, on tasks emphasizing skill with equipment and psychomotor activities.

The results can be expected to generalize to other units. In this study, three replications with basically the same results were obtained. The two Active Army posts and the National Guard division were so similar in patterns of performance as to constitute three independent verifications of the same basic results, with minor exceptions.

A final point concerns the way in which the TEC lesson usage was constrained by time and circumstances for this research effort. For example, the soldiers had no choice about which lessons to take, nor were they allowed to bypass a lesson if they already knew the material. Operational aspects, such as the availability of equipment for viewing, or reliability of equipment and software, were not addressed. The evidence is clear that TEC lessons consistently improved soldiers' performance as much as or more than the alternatives.

TRAINING INDIVIDUALS IN ARMY UNITS: COMPARATIVE EFFECTIVENESS OF
SELECTED TEC LESSONS AND CONVENTIONAL METHODS

TECHNICAL SUPPLEMENT

TRAINING INDIVIDUALS IN ARMY UNITS: COMPARATIVE EFFECTIVENESS OF SELECTED TEC LESSONS AND CONVENTIONAL METHODS

The effectiveness of selected TEC lessons was compared to that of conventional training on the same topics. Effectiveness was measured using hands-on performance tests that were administered after the training programs to soldiers in the Active Army and National Guard. The following sections first describe lesson selection, samples of soldiers, experimental training procedures, performance tests, and statistical analysis for the research as a whole. Specific procedures and results in the Active Army and National Guard are then presented separately.

GENERAL PROCEDURES

Selection of Lesson Categories

TEC lessons are organized into categories according to content, and the lessons within a category are aimed at a particular target audience. The target audience may contain a single MOS or branch, or more than one branch. The target audience designation is "common" if the lessons are appropriate for soldiers in all eight of the MOS that were analyzed in the systems engineering study.[5] Two examples of lessons developed for the common target audience are Hand Grenades and the M16A1 Rifle. Surveyed Firing Chart lessons for the 13E MOS represent an example of MOS-specific lessons.

Lesson categories were assessed in the present research rather than separate lessons. The lesson categories evaluated covered the following topics: Hand Grenades, Light Antitank Weapon (LAW), M16A1 Rifle, 81mm Mortar Fire Direction Computer (Mortar FDC), and Surveyed Firing Charts. Selection of categories was based on the following considerations: (1) the lessons had been produced by October 1974, to allow sufficient time to conduct the research within the required time frame; (2) either suitable performance tests or performance objectives were available; (3) categories evaluated in other research projects were avoided (e.g., Squad Radio, Land Navigation); and (4) lessons produced by two lesson development projects were included. Four of the five lesson categories were produced under the direction of the U.S. Army Infantry School (USAIS). The USAIS had previously produced TEC I lessons and therefore had experience in the process. As a result, more of the USAIS lessons were produced in time for the research than were lessons from other service schools. One Field Artillery lesson category, produced by another project, was evaluated.

The lessons selected for evaluation are listed by category in Table 5. The number of lessons in a category varied from two on the LAW category to six Surveyed Firing Charts lessons. The Surveyed Firing Charts category contains a seventh lesson that presents practical exercises and

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[5] McCluskey, Jacobs, and Cleary, 1974, op. cit.

Table 5

LIST OF SELECTED TEC LESSONS, BY CATEGORY

Lessons by Category	Lesson Identification Number
Hand Grenades	
1. The Hand Grenade - Types and Uses	942-071-0001
2. Hand Grenade Maintenance and Identification	942-071-0002
3. The Hand Grenade - Carrying, Aiming and Throwing	942-071-0003
Light Antitank Weapons (LAW)	
1. Operating the LAW	948-071-0005
2. LAW - Engaging the Target	948-071-0006
M16A1 Rifle	
1. M16A1 Rifle - Loading and Unloading	939-071-0009
2. Disassembling and Assembling the M16A1 Rifle	939-071-0010
3. Maintaining the M16A1 Rifle	939-071-0011
4. M16A1 Rifle - Preventing and Correcting Common Malfunctions	939-071-0012
81mm Mortar Fire Direction Computer (FDC)	
1. Fire Direction Computer - An Introduction	010-071-6601
2. Fire Direction Computer - The Observed Firing Chart (Part I)	010-071-6602
3. Fire Direction Computer - The Observed Firing Chart (Part II)	010-071-6603
4. Fire Direction Computer - The Observed Firing Chart (Part III)	010-071-6604
5. Fire Direction Computer - The Observed Firing Chart (Part IV)	010-071-6605
Surveyed Firing Charts	
1. Surveyed Firing Charts: Use of Plotting Scale	250-061-6301
2. Surveyed Firing Charts: Use of Coordinate Scale	250-061-6302
3. Surveyed Firing Charts: Polar Plotting	250-061-6303
4. Surveyed Firing Charts: RDP-Range and Deflection	250-061-6304
5. Surveyed Firing Charts: Use of the Target Grid	250-061-6305
6. Surveyed Firing Charts: Determine Angle T	250-061-6306

the criterion test for the entire category; the handling of this lesson
is described later. The Mortar FDC category has other lessons in devel-
opment in addition to the five lessons named in Table 5; the lessons
listed in the table present an entire instructional block concerning
the observed firing chart, while the additional lessons present instruc-
tion on other aspects of mortar fire direction procedures. The block
of five lessons was assessed in lieu of the entire category.

The entire lesson categories on Hand Grenades, LAW, and the M16A1
Rifle were assessed. These three infantry weapons categories all have
common target audience designations. The 11C MOS is the target audience
for the Mortar FDC lessons, and the 13E MOS is the target audience for
the Surveyed Firing Charts category.

Experimental Groups

The effectiveness of each TEC lesson category was assessed by
comparing the three experimental groups. In the experimental training
conditions, soldiers were trained either on the TEC materials (TEC group)
or by conventional instruction approaches (CI group). In the third
condition, soldiers received no special training during the course of
the research (Baseline group). The research procedures for each experi-
mental group are described in the following paragraphs and portrayed in
Figure 3. Procedures specific to the Active Army or National Guard are
presented in separate sections.

TEC. At the onset of each TEC training session the research per-
sonnel briefed the soldiers on the research requirement, use of TEC, and
confidentiality of their individual scores. The soldiers were then
given the LAI pretest for the first TEC lesson. Because the pretest and
knowledge of results are part of the TEC instructional strategy, the
soldiers were informed of the results of their answers. After the LAI
pretest, the TEC lesson was individually administered. When the soldier
completed the lesson, he was given the LAI test again as a posttest and
was again told the results of his answers.

Generally, the sequence of pretest, TEC lesson, and posttest was
repeated for each lesson in the category; i.e., twice for the LAW,
three times for Hand Grenades, and five times for Mortar FDC. The M16A1
Rifle category required one deviation from the sequence because the LAI
test was omitted for one lesson. The omitted test consisted entirely of
mechanical demonstrations which were not feasible to score in the research;
therefore, the lesson was given without the pre- and posttests. The
Surveyed Firing Charts category was another exception to the sequencing.
In this category, the seventh lesson contains the test items and practical
exercises. A written test produced from that lesson was administered
as a pretest. Afterward, the soldier studied the six lessons. The same
written test was repeated after the sixth lesson.

Practice materials such as weapons and other equipment are recommended
for practical exercises during some TEC lessons. These practice materials
are listed in the LAI. For some lessons, such as Surveyed Firing Charts,
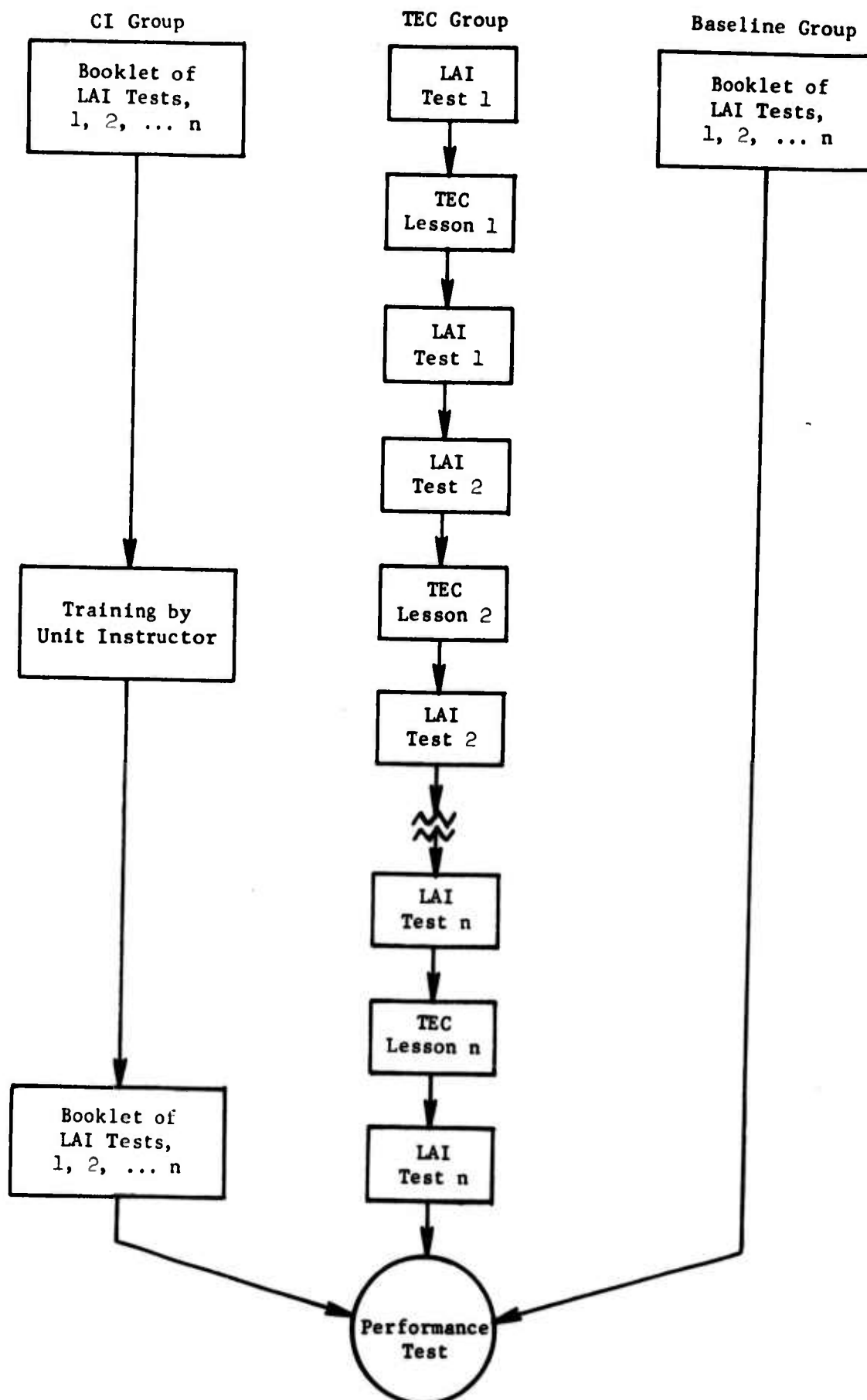
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Figure 3. Flow diagram of experimental procedures

materials are supplied by the service school, but for other lessons the units provide the equipment. These materials were supplied to the soldiers for the research TEC training, with some exceptions.

Conventional Instruction. Training for the conventional instruction (CI) group was organized by the training staff of the unit participating in the research. The class was taught by an instructor selected by the unit. The training staffs had access to the standard Army materials, such as Army Subject Schedules, Technical Manuals, Training Manuals, and training aids. They were restricted only from using the TEC lessons in the selected lesson categories. Although types of instruction were not sampled systematically, the training conducted was within the customary range of unit training for individual skills.

The LAI test administration and presentation of the lesson content were different in the CI experimental condition than for TEC. All LAI tests for the course were administered in a single package prior to the beginning of the CI training session. The test items were exactly the same as those administered to the TEC soldiers but the items were administered in a single test to the CI soldiers. The CI group then received training that covered the material selected by the unit training staff. After completion of the class, the LAI test package was given again. The performance tests were administered the next day in the National Guard and the next week in the Active Army, following the same procedures used for the TEC and BL soldiers.

Baseline. The Baseline (BL) group did not receive any training on the content of the TEC and CI lessons during the course of the research. Soldiers in this group were given the LAI pretests in the same manner and same time frame as the CI group. After the LAI pretest, the BL soldiers returned to their ordinary duties. The BL soldiers were given the final performance test on the same days as the TEC and CI soldiers.

The BL performance reflected the cumulative effects of prior training and experience, and established a basis for comparison with the two training groups. The TEC and CI groups had the prior training plus the training conducted during the research. Thus, the incremental effects of current refresher or cross-training could be assessed relative to the baseline.

Training Objectives

The objectives included in the TEC lessons, conventional training, and performance tests were identified with the help of the combat service schools and research personnel involved in the systems engineering of the eight combat MOS. An effort was made to have the same objectives included in both types of training and in the performance tests. After the training objectives for the present research had been identified, brief lists were compiled for the training staffs of the CI units, to help keep the training content of the CI group comparable to the TEC group. Objectives supplied to the training staffs are listed in Appendix A.

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The measures of primary importance were criterion-referenced performance tests. These tests were relevant to the lesson content in both the TEC and CI training but they were not designed specifically to evaluate the TEC lessons. After the training objectives were identified, a survey was conducted of existing criterion-referenced performance tests of those objectives. The use of recognized tests that had been subjected to prior trial was preferred to the development and use of untried tests. Where existing tests were available, they were used even if they did not cover all of the objectives included in the TEC and CI training.

In addition to existing performance tests, performance objectives were obtained from another ongoing research project. These performance objectives, based on tasks identified as critical or important in the systems engineering study of training, had been reviewed by the combat service schools during their development. The performance objectives were used in two ways. First, they were used to edit the existing performance tests to insure that the tests were complete and up to date. Some sections of the existing tests were deleted or revised. Second, the performance objectives were used as a basis for writing performance tests for lesson categories, or sections of lesson categories, not covered in existing performance tests.

The scope of the objectives assessed in the performance tests was limited for several reasons. Complete, validated performance objectives were available for some, but not all, of the training objectives. These validated performance objectives constitute the most recent and complete criterion materials, and development of new tests was restricted to elements in the performance objectives.

The performance test format was standardized for all lesson categories. The format was taken from the Guidelines for the Conduct of Performance Oriented Training (TRADOC Pamphlet 600-11)[6] and is used in the Soldier's Manual Army Testing (SMART) books. The test situation, conditions, standards, and necessary equipment were specified and the performance requirements were described. Each item was dichotomously scored on a "go" or "no go" basis. The soldier's final score equaled the total number of items on which he achieved a "go" score. The performance tests are described in Appendix B.

After the performance tests were compiled, the test administrators from the 100th Division (Training), USAR, Test Section practiced the infantry tests, demonstrated them to the researchers, and suggested revisions. Test administration teams practiced the revised tests

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[6] U.S. Army Training and Doctrine Command. TRADOC Pamphlet 600-11, Guidelines for the Conduct of Performance Oriented Training. Fort Monroe, Va., 22 October 1973.

together to enhance consistency of scoring from one administrator to another. Additionally, teams resolved practical issues such as holding areas for soldiers waiting to be tested, introductory comments, techniques to prevent the administrator from knowing the soldier's experimental training group, and the conduct of movement through the test environment. Within a lesson category, the same group of test administrators conducted the tests at all research locations in the Active Army and National Guard.

Similar practice and review processes were conducted by the Surveyed Firing Charts test administrator from the Field Artillery School. The same test administrator gave the Surveyed Firing Charts performance tests at both Active Army posts.

In administering the performance tests, testing stations were positioned so that individual examinees could not observe before, during, or after testing, what the others were doing. The testing was done on a one-to-one basis, except in the case of Mortar FDC where it was possible for each tester to monitor two examinees. Examinees were assigned to one of three groups, one group per hour, for the performance testing. Examinees were mixed as to training group and performance testers were not informed of which training individual examinees had received. After taking the performance test, examinees were routed away from men waiting to be tested and not allowed to mingle with them.

Statistical Analysis

Table 6 lists the tests scored and background information items collected from all soldiers. Analyses were performed separately for each lesson category and for each population (Active Army and National Guard).

The analysis proceeded in two stages. The objective of the first stage was to determine the comparability of the three experimental groups (TEC, CI, and BL), as the performance test analysis in the second stage depended upon the comparability of the experimental groups.

LAI test scores and background information. In addition to the LAI test scores, several items of background information were obtained from the soldiers' records in order to assess experimental group comparability. The General Technical (GT) aptitude area score was obtained as a measure of general mental ability. The GT and LAI pretest scores were subjected to a one-way analysis of variance comparing the experimental groups.[7] The remaining background variables (pay grade, primary MOS, prior training, and time in service) were inspected for differences in frequency.

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[7] Winer, B. J. Statistical principles in experimental design. New York: McGraw-Hill, 1971.

Table 6

EXPERIMENTAL VARIABLES FOR STATISTICAL ANALYSIS

Variable	Description
Tests Scored:	
Performance Test	Hands-on measure of skills after training; scored by the total number of "go" points
LAI Pretest and Posttest	Written tests that accompany the TEC lessons; given before and after training and scored by the number of correct answers
Background Information:	
General Technical Aptitude Area	Composite of verbal and arithmetic aptitude from the Army Classification Battery; scores obtained from soldier's records
Primary MOS	11B, 11C, 11D, 11E, 13A/B, 13E, or other
Pay Grade	Coded E1 to E9
Time in Service	Intervals of 1/2 year up to 4 years, and more than 4 years
Previous Training	No training on the research topic; BCT only; BCT and AIT; other training on the topic but not BCT or AIT; BCT, AIT, and other training

Performance test scores. If there were no significant differences on the background variables and LAI pretest among experimental groups, the performance test scores were subjected to a one-way analysis of variance. If significant differences were found among the experimental groups on the GT and LAI pretest scores, an analysis of covariance was performed using the variable on which the groups differed as the covariate.

Since the Active Army data were collected from two posts, a two-way analysis of variance was performed to investigate interactions among sites and experimental groups. The Active Army data were pooled over posts when the same pattern of results occurred at both posts.

When the analysis of variance or analysis of covariance indicated overall significance, Scheffe''s method[8,9] was used to compare results between pairs of experimental groups (TEC vs CI; TEC vs BL; CI vs BL).

GT, LAI pretest, and performance test correlations. To determine the relationships among general mental ability, prior knowledge, and final performance, correlations were computed among these three variables within each lesson category. In addition, the correlations were computed within each experimental group to investigate differential effects of the TEC and CI approaches.

ACTIVE ARMY EXPERIMENT

Samples and Procedures

Fort Lewis, Washington and Fort Carson, Colorado provided support for the Active Army portion of the research, a total of 285 participants. At Fort Lewis, samples were drawn from five infantry battalions in two brigades and from a combat support battalion. At Fort Carson, two battalions from a single brigade provided the infantry support. At each post, division artillery supplied three battalions for the field artillery lessons.

Subject matter experts and other personnel in the service schools that produce the selected courses provided assistance in designating the target populations of soldiers for evaluating specific lessons. When the lesson category target audience contained a single MOS, the exact duty positions or skill levels appropriate for the lessons were specified. The lesson categories designed for single MOS were Mortar FDC (for 11C) and Surveyed Firing Charts (for 13E). Soldiers with the 11B MOS were selected for evaluating the lessons developed for the common target audience, due to the large number of available soldiers in this MOS. Soldiers in combat support MOS (largely 36 series: Wire Maintenance) were also used to evaluate the M16A1 Rifle category so that the common audience lesson samples were not limited to infantry units.

Regardless of MOS and duty position, the battalions were asked to provide soldiers who needed cross-training or refresher training. The distribution of MOS by lesson category is given in Appendix C (Table C-1).

Within the lesson categories, the soldiers in the three experimental groups were similar in pay grade, time in service, and previous training (Appendix C, Tables C-2, C-3, and C-4). Most of the soldiers in the

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[8]   Scheffe', H. A method for judging all contrasts in the analysis of variance. Biometrika, 1953, 40, 87-104.

[9]   McNemar, Quinn. Psychological statistics. New York: Wiley, 1962.

Hand Grenade and M16A1 Rifle samples reported training in BCT and AIT. With few exceptions, formal training from other sources (e.g., correspondence courses) was not reported in these topics. Compared to those categories, more soldiers in the LAW and Mortar FDC samples reported either no previous formal training or reliance on training other than BCT or AIT. Battalion representatives reported that training on these infantry topics is conducted concurrently with field training. Thus, informal training is given in addition to the training reported by these soldiers. The field artillerymen all reported some training in Surveyed Firing Charts. A few men had AIT plus other formal training or other training but not AIT.

The soldiers in all lesson categories tended to be in their first enlistment. With few exceptions, they had 6 months to 2 years in the service and were in pay grades E2 through E4.

LAI pretest and GT scores. Comparisons of the LAI pretest and GT scores for the experimental training groups in each lesson category are presented in Appendix C (Tables C-5 and C-6). Analyses of variance performed on each variable indicated no significant differences among experimental groups in four of the lesson categories: Hand Grenades, LAW, M16A1 Rifle, and Surveyed Firing Charts. In the Mortar FDC lesson category the CI group means on both GT and on the LAI pretest were lower than the means of the other two experimental groups on the same variables. The LAI pretest means represented 74% correct for the TEC group and 71% for the BL group but only 57% correct for the CI groups. In GT scores, the TEC group mean was 114.12, the BL group mean was 115.69, and the CI group mean was 102.11.

TEC instruction. TEC training was conducted in battalion learning centers or classrooms set up to serve as learning centers. Five or six soldiers were individually trained in each session, except in one session when ten men were trained on the M16A1 Rifle category.

The LAI testing and lesson sequence procedures were implemented as shown in Figure 3. The equipment listed on the LAI for the Mortar FDC and Surveyed Firing Charts was supplied to the soldiers for practice during the lessons. However, not all of the equipment for practice during the M16A1 Rifle TEC lessons was available to all of the soldiers who studied those lessons. The lessons had not been available for review prior to the research and the LAI did not indicate that cleaning kits were required during training. Therefore, the cleaning kits were not requested for the men and were not provided during training at the first post. In the lesson, the instructions requested use of equipment from the kit only at one point, which was during rifle disassembly. Lack of the kit had little effect on the practical exercise; in fact, the disassembly procedure is normally accomplished with implements other than those in the cleaning kit. The first post provided two sample groups for the M16A1 Rifle lessons. One sample had rifles for practice although they did not have the cleaning kits. In the other TEC group at the first post, however, the lack of practice equipment was more serious. Although the men had been requested to have their rifles, they did not get them

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out of the arms room because the armorer had the day off. The soldiers in this TEC group had no practice equipment. By the time of the training at the second post, the complete practice equipment requirements were known and the soldiers had the equipment for practice during the TEC lessons.

Conventional Instruction. The CI training was conducted in the battalion or company classrooms. From ten to twelve soldiers were given the LAI tests and trained in a group. Aside from these similarities, wide differences occurred in several aspects of the unit instructor training. For example, the instructors' pay grades varied from 03 to E3. The class durations ranged from 1 to 6 hours. Most but not all of the classes included practical exercises. Approximately ten soldiers were trained in each class so that a total of twenty soldiers were trained in each topic in the Active Army. For the M16A1 Rifle, an additional combat support battalion trained ten soldiers, bringing the Active Army total to 30 soldiers in that category. Further description of each class is given by lesson category in Appendix C.

Results and Discussion

Performance test scores. Performance test analyses in the Active Army showed significant differences for all lesson categories except for the M16A1 Rifle. In summary, in the Hand Grenade and Surveyed Firing Charts categories TEC means were higher than the means for the other experimental groups, but the CI group was similar to the BL group. In the Mortar FDC category, the TEC mean was higher than the BL mean and the CI mean was in the middle. The TEC and CI means for the LAW were about the same while the BL mean was lower than either. Analysis of covariance using the LAI pretest, GT, or both LAI pretest and GT scores did not alter these patterns.

Possible performance test score differences between the two Active Army posts were also examined. Two-way analyses of variance indicated no significant main effects for the posts, no interactions between posts, and no interactions between posts and experimental training groups in Hand Grenades, LAW, and Mortar FDC. For these three categories, however, significant main effects of the training repeated the results of the one-way analyses. The results for these lessons are shown in Table 7, and the summaries of one-way analysis of variance are presented in Appendix C (Table C-7).

Analysis of the Surveyed Firing Charts performance tests showed significant differences between the two posts and among the three training groups (Table 8 and Appendix C, Table C-9). At the first post, the performance test score mean over the three training groups was 28.13, or 85% correct, while at the second post the mean was 22.66, or 67% correct. The TEC groups at the two posts had approximately the same level of performance (85% and 91%) as did the BL groups (65% and 75%). The CI groups, however, differed between the two posts (54% and 91%). At one post, the CI mean equaled the TEC mean on the performance test. The Surveyed Firing Charts CI class at this post had the highest ranking

Table 7

ACTIVE ARMY PERFORMANCE TEST SCORES: MEANS, STANDARD DEVIATIONS,
AND PERCENT CORRECT BY LESSON CATEGORY AND TRAINING GROUP

| Lesson Category | | Training Groups | | | F | df |
		TEC	CI	BL		
Hand Grenades	MEAN	21.46	12.47	13.00	13.85***	2,45
	SD	5.08	5.72	4.59		
	%	74%	43%	45%		
	N	13	15	20		
LAW	MEAN	14.17	14.69	11.21	3.71*	2,50
	SD	4.53	3.44	4.29		
	%	57%	59%	45%		
	N	18	16	19		
Mortar FDC	MEAN	40.82	23.44	15.06	5.77**	2,48
	SD	21.30	24.56	20.65		
	%	72%.	41%	26%		
	N	17	18	16		

*** $p < .001$
** $p < .01$
* $p < .05$

Table 8

SURVEYED FIRING CHARTS PERFORMANCE TEST SCORES: MEANS, STANDARD
DEVIATIONS, AND PERCENT CORRECT BY TRAINING GROUP AND ARMY POST

| Army Post | | Training Groups | | |
		TEC	CI	BL
A	MEAN	29.90	29.90	24.60
	SD	1.79	2.96	5.93
	%	90.60%	90.60%	74.54%
	N	10	10	10
B	MEAN	27.91	17.90	21.38
	SD	6.56	12.57	10.64
	%	84.57%	54.24%	64.77%
	N	11	10	8

instructor (O3) in the research. In addition, he had recently served as
an instructor at the Field Artillery School. The difference between this
officer's experience and that of other instructors in the research may
account for the high level of performance of this group. The Surveyed
Firing Charts instructor at the other fort, where the CI group mean was
well below the TEC mean, was in about the center of the range of ranks
among instructors in the research (E7).

The difference between the CI groups reflects the wide variation in
training described previously. Considerable variation has been observed
Army wide, although it was not specifically under scrutiny in the present
research. Standardization of training is one of the potential strengths
of the TEC training materials, which present the same content within a
lesson category regardless of Army unit or location. For example, the
TEC lessons presented standardized Surveyed Firing Charts content to the
TEC groups at both Army posts. More importantly, the TEC training was
not only standardized but effective in producing final performance equal
to the highest attained by a unit instructor.

As noted earlier, the soldiers studying the M16A1 Rifle TEC lessons
lacked practice equipment in two of the three battalions tested. No
significant differences between experimental training groups occurred
regardless of whether the TEC trainees had the practice equipment. One-
way analysis of variance of the data gathered at the second post, where
all equipment was provided for TEC training, showed the same results as

data from the first post and the data for both posts combined; performance scores for TEC, CI and BL groups did not differ reliably. A two-way analysis of variance separated the training group results for the three units at the two posts (Table 9 and Appendix C, Table C-8). Although there was no significant main effect of training groups or interaction between groups and units, the main effect of differences among units was significant ($\underline{F}$ (2, 65) = 9.21, p < .001). The means in all three training groups were nearly equal for the two units at the first post (36.85 in the combat support unit and 39.38 in the infantry brigade), while the mean at the second post was higher (49.47).

Table 9

ACTIVE ARMY M16A1 RIFLE PERFORMANCE TEST SCORES: MEANS, STANDARD DEVIATIONS, AND PERCENT CORRECT BY TRAINING GROUP AND UNIT

Unit		Training Groups		
		TEC	CI	BL
Post A, Infantry Battalions	MEAN	36.43	35.75	44.89
	SD	11.65	10.89	7.54
	%	54%	53%	66%
	N	7	8	9
Post A, Combat Support Battalions	MEAN	43.29	30.67	35.71
	SD	10.86	11.29	16.97
	%	64%	45%	53%
	N	7	6	7
Post B, Infantry Battalions	MEAN	51.92	48.62	47.20
	SD	9.40	8.28	10.26
	%	76%	72%	69%
	N	12	8	10

Individual comparisons among the means for the three TEC groups were not significant. Thus, the TEC group means did not account for the overall unit differences. This also indicates that differences in practice equipment during training did not produce significant differences among means in the TEC training units. Although it may be by chance, the

three performance test means increase in the same order as the increase in training equipment: 36.43 for the infantry unit with no practice equipment; 43.29 for the combat support unit with only rifles; and 51.92 for the infantry unit with all required practice equipment. It remains plausible that the lack of practice or the adverse effects on motivation of lack of practice equipment degraded training effectiveness. Given the irregularities for the TEC training in the Active Army, the results should be discounted. Results for the M16A1 lessons in the National Guard appear to be more accurate reflections of the effectiveness of TEC.

The effects of practice may also account in part for the differential effectiveness of the lesson categories. Two of the TEC categories that were highly effective, compared to the other experimental groups, were on Mortar FDC and Surveyed Firing Charts. The lessons in these courses guided the soldiers through extensive practical exercises.

In contrast, the LAW lessons do not require practice and they did not produce mechanical performance superior to the conventionally trained group. Although practice is not required in the LAW lessons, the applicability of hands-on practice is noted on the LAW LAI and left to the discretion of the trainer. Stronger recommendation or lesson revision incorporating the practical exercise may be advisable.

Correlations among performance test, LAI pretest, and GT scores. Correlations among the performance test, LAI pretest, and GT scores by lesson category and experimental training group are presented in Appendix C, Table C-10). Correlations were averaged (using the z transformation from Fisher [10]) to obtain a descriptive overview of the results. The average correlation between performance test and LAI pretest scores, over all lesson categories, was .54. Among lesson categories, the correlations were higher for the performance tests that were cognitive rather than mechanical, such as Hand Grenades (average $r = .65$). High correlations in the Mortar FDC (average $r = .64$) and Surveyed Firing Charts (average $r = .59$) reflected the similarities of the performance tests and pretests in those topics. The pretests contain exercises covering the same material as the final performance tests, so that the same skills are tested although the particular problem to be solved is different. In contrast, lower average correlations occurred for courses in which the hands-on performance tests differed in nature from the written LAI tests. Thus, the average correlation between the LAW LAI pretest and performance test was .41, and the average correlation in the M16A1 Rifle category was .35.

The average correlation between GT and the performance test scores was .27. Overall, GT related slightly higher to the written LAI pretests (average $r = .45$) than to the performance tests.

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[10] Fisher, R. A. Statistical methods for research workers. London: Oliver & Boyd, 1936.

LAI pretest to posttest changes. As noted previously, the LAI pretest scores for the experimental groups were similar within lesson categories except in the Mortar FDC category. Given the differences in LAI test procedures in the TEC and the CI groups, it is not the comparison of posttest scores between the groups that is of interest but rather pretest to posttest comparisons within experimental training groups. The LAI pretest and posttest results, given as percent correct of the total possible number of points, are presented in Appendix C, Table C-11.

In the Hand Grenades, LAW, M16A1 Rifle, and Surveyed Firing Charts categories the TEC groups attained less than 50% correct in the LAI pretest. The LAI posttest scores on these tests, given immediately after the soldiers studied the TEC lessons, showed large increases. After the M16A1 Rifle lessons the scores were close to 80% correct and after the Hand Grenades and LAW lessons the scores averaged over 80% correct. On the Surveyed Firing Charts posttest, which required detailed skills, the average was 67%. The posttest scores on Surveyed Firing Charts may be lower than on other categories because of fatigue effects; the Surveyed Firing Charts training was longer than training on the other lesson categories. The gain was less on the first Mortar FDC LAI test because of the high initial scores (averaging 74% correct). However, this test had the highest posttest level (94%), so that the amount of gain was restricted by the 100% correct maximum. The LAI posttest scores indicate a high level of knowledge of the material immediately following the TEC lessons. As measured on these written tests designed for the TEC lessons, the TEC training was highly effective.

The CI group gained slightly between the LAI pre- and posttests. On the LAI pretests in Hand Grenades, LAW, M16A1 Rifle, and Surveyed Firing Charts the CI groups achieved close to 40% correct and on the posttests in these categories they achieved less than 60% correct. The gains on the Mortar FDC LAI test were also small, although the scores were higher than the scores in the other courses. The Mortar FDC pretest average was 57% correct and the posttest average 72% correct for the CI group.

GT and LAI test comparisons for men who did not take performance tests. Several men who participated in the training and LAI testing portions of the research did not take the performance tests. The GT and LAI test scores of these men were compared to the analogous scores of the men who did take the performance test, and the GT and LAI test score means of each training group within lesson categories were computed including both the men who took the performance tests and the men who did not. The difference in GT and LAI means that resulted from including these men was less than one point in most cases, and was greater than two points in only two cases. The GT scores of the men who did not take the performance test were lower than the GT scores of the men who did take the test in the TEC group for Hand Grenades and in the CI group for the M16A1 Rifle. The GT mean for the TEC group in the Hand Grenades lesson category was five points lower when the men who did not take the performance test were included. However, since the correlation between GT and performance test score is zero for that group, there is no likely effect on the performance test results.

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In the M16A1 Rifle lesson category, inclusion of the men who did not take the performance test lowered the GT mean for the CI group by four points. If all of the men had been tested, it is possible that the CI group would be further below the TEC and BL groups than was found. However, a large change would be needed to change the significance of the performance test analysis. In addition, the GT score results do not alter the recommendation, for other reasons, to disallow this M16A1 Rifle data from the Active Army results.

In the M16A1 Rifle category, a CI group was interrupted by an inspection during the training. Rather than continue to use this group, the same instructor presented another CI course to a new sample of soldiers from the same battalion. The performance test score analysis contained data from the second group rather than the interrupted group. The GT and LAI test scores of the two groups were compared to determine possible effects of replacing the group. The means and standard deviations of the scores are as follows:

	Interrupted Class (N = 11)	Replacement Class (N = 6)
GT mean	93.73	99.67
standard deviation	9.92	13.95
LAI pretest mean	24.91	21.33
standard deviation	6.76	8.87
LAI posttest mean	32.86	28.67
standard deviation	9.56	4.76

Although the GT level was slightly higher and the LAI test scores were slightly lower for the replacement group, the differences were small and were not statistically significant. It is unlikely that any systematic effects were produced by using the replacement group rather than the original group that was interrupted.

NATIONAL GUARD EXPERIMENT

Samples and Procedures

The 38th Division, which contains the National Guard of Indiana, Ohio, and Michigan, provided samples of men at four different sites: Tell City, Indiana; Cincinnati, Ohio; Big Rapids, Michigan; and Martinsville, Indiana. The lesson categories were LAW, Mortar FDC, M16A1 Rifles and Hand Grenades. The research with the National Guardsmen was conducted during their regular weekend of training. At each site the 60 men identified were divided into three groups of approximately equal size. Men were assigned to each group on a random basis. An attempt at stratification was made by assigning approximately equal numbers of each Army pay grade within a group. After the groups were so formed, ARI representatives, through random drawing, determined the assignment of the groups to one of the three experimental conditions (TEC, CI, or BL).

TEC group. Training in lesson categories LAW, M16A1 Rifle, and Hand Grenades was completed within the first day (Saturday). In the Mortar FDC category, because of the length and nature of the lessons, only four lessons were given; three lessons were completed on Saturday and the fourth on Sunday morning.

Two problems occurred with the Mortar FDC TEC training. The first was the supplying of the group with Lesson No. 010-071-6602-F (Part I) to begin the session. The correct procedure would have been to begin with Lesson No. 010-071-6601-F (Introduction). Evaluation of the lessons' contents, observation of the LAI posttest scores, and the fact that 17 of the 18 men in the group carried the 11C MOS, led to the conclusion that the out-of-sequence lesson had only a minor decremental effect on the group's learning.

A second problem was the lack of a sufficient number of good M16 plotting boards. Of the 23 boards available, several of which were in poor condition, 12 were allotted to the CI group and 11 to the TEC group; thus each individual did not have his own board.

Conventional Instruction. For the CI group, an instructor was designated by the unit at least one week before the training session. He was provided with the training objectives described previously. The time for his presentation (one day) was specified as equivalent to TEC training time. The instructor was directed to conduct his training sessions in the normal mode of Army training, i.e., he could study field manuals, order audiovisual aids, use hands-on demonstrations, etc. He was informed before the training that the results as compared against the TEC effort would not be considered an indication or evaluation of his own personal ability as instructor.

LAI pretests and posttests were administered at a single sitting, as described previously. In contrast to the TEC group, men in the CI group were not permitted to check their answers against a list of correct answers. After the instructor indicated his training was completed, the LAI posttests were administered to the group. See Appendix D for the training scenarios by lesson category.

Baseline group. The Baseline group was administered the LAI pretests in the same manner at the same time as the CI group. The Baseline group received no training pertaining to the lesson category which was being run that weekend. National Guard officers in charge were requested to either give these men some form of cross-training or assign them to ongoing unit duties or exercises.

Performance testing procedures. All performance testing took place on Sunday, the day after the men received their training in the course. The performance tests used for the four lesson categories (LAW, Mortar FDC, M16A1 Rifles, Hand Grenades) were the same as those used with the Active Army samples, with two exceptions. In the case of Mortar FDC, Performance Measure 9 was deleted since it dealt with material not

covered by the four TEC lessons given in the National Guard. In the case of Ml6Al Rifles, one performance measure was deleted since it required the examinee to switch his rifle to the AUTO position, a position which is "stopped" on the National Guard rifles.

Descriptions of training groups. Tables D-1 through D-4 in Appendix D detail respectively the primary MOS, pay grade, time in service, and previous training for each training group and lesson category of the 215 participants. Inspection of the tables indicated that within a lesson category there were only minor differences in distributions for the background variables. The groups were very similar; only three individuals in the total sample for all categories had job MOS different from infantry.

Table D-5, in Appendix D, reports the means, standard deviations and F values for differences between training groups for each lesson category on the LAI pretest. None of the F tests was found to be significant at $p < .05$. The training groups had approximately the same average information about the lesson content before training, and therefore a difference between groups on the performance tests was not a function of differences in prior knowledge as measured by the LAI tests.

Table D-6, in Appendix D, reports the means, standard deviations, and F values for differences between groups on GT aptitude area scores for each lesson category. Only the F test for Ml6Al Rifle (F (2, 40) = 3.45, $p < .05$) was significant. The training groups for the remaining three lesson categories were assumed to be equal in general mental ability, therefore, and differences in performance test results were assumed not to be a function of mental ability. The differences between training groups for the Ml6Al Rifle were adjusted statistically by use of the analysis of covariance technique for both GT and LAI pretest differences.

With the exception of the reported difference in GT for the Ml6Al Rifle category, the training groups were found to be similar in terms of background variables, prior information, and general mental ability. Therefore the observed differences in performance test scores are likely to be due to training or treatment effects and not to prior group differences.

Results and Discussion

Performance test scores. The means, standard deviations, average percent correct, and F tests for performance test scores for each lesson category and training group are presented in Table 10. Summary tables for the analyses of variance and covariance are presented in Tables D-7 and D-8 in Appendix D. The F tests for difference between training groups were significant in all four lesson categories.

The analysis for the LAW lesson category indicated that both the TEC and CI group differed from the BL group but did not differ from each other. Further, both the TEC and CI groups achieved a mean percentage

Table 10

NATIONAL GUARD PERFORMANCE TEST SCORES: MEANS, STANDARD DEVIATIONS, AND PERCENT CORRECT BY LESSON CATEGORY AND TRAINING GROUP

		Training Groups				
Lesson Category		TEC	CI	BL	F	df
Hand Grenades	MEAN	21.05	13.90	11.37	22.44***	2, 56
	SD	4.15	5.45	3.96		
	%	70%	46%	38%		
	N	20	20	19		
LAW	MEAN	17.26	17.00	12.30	7.14**	2, 56
	SD	4.64	4.56	4.39		
	%	69%	68%	49%		
	N	19	20	20		
M16A1 Rifle	MEAN	48.73	47.13	30.92	10.65***	2, 40
	Adj. Mean[a]	49.13	46.37	31.35		
	SD	9.21	8.63	10.88		
	%	76%	74%	48%		
	N	15	15	13		
Mortar FDC	MEAN	24.61	19.18	8.68	3.61*	2, 51
	SD	19.01	19.79	14.50		
	%	45%	35%	16%		
	N	18	17	19		

[a] Mean adjusted for LAI pretest and GT scores

*** p < .001

** p < .01

* p < .05

of correct items of a little less than 70% while the BL group achieved 50%. A similar pattern was found for the M16A1 Rifle category with the TEC and CI group achieving slightly more than 70% average correct number of items.

A different pattern emerged for the Mortar FDC and Hand Grenades performance test scores. For Mortar FDC the TEC group tended to have a higher mean than the CI group and the CI group tended to be higher than the BL group (mean percent correct, TEC = 45, CI = 35, and BL = 16). The results for the Hand Grenade performance test were stronger, with the TEC group having a higher mean than either the CI or BL group (mean percent correct, TEC = 70, CI = 46, and BL = 38).

The two distinct patterns of findings reported above for LAW and M16A1 Rifle training vs Mortar FDC and Hand Grenade training would seem to reflect the underlying skills being tapped by their performance tests. The LAW and M16A1 Rifle lessons emphasized psychomotor or manual skills while the Mortar FDC and Hand Grenade lessons were more concerned with verbal or cognitive skills.

The data support the conclusion that TEC training consistently produced improved performance over that of a group not receiving current training (BL) while training by unit instructors (CI) improved performance primarily in the manual and psychomotor skills.

Correlations among performance test, LAI pretest, and GT scores. The correlation results for the National Guard were similar to the Active Army pattern. The mean correlations between the tests were: performance and LAI pretest, .34; GT score and performance test, .24; and GT score and LAI pretest, .31. The National Guard correlations of LAI pretest with GT score and performance test were smaller than for the Active Army, but the general pattern of higher correlations for cognitive skills and lower correlations for manual skills was replicated. The correlations are detailed in Appendix D, Table D-9.

LAI pretest to posttest changes. Since the LAI tests were developed to cover the content of the training and there was some concern with the degree to which learning as measured by the LAI tests had occurred, a check on the difference between LAI pretest and posttest scores was made. Table D-10 in Appendix D gives the mean percentages correct for each lesson category by training group on the LAI pretests and posttests. The TEC groups went from a pretest mean percent correct in the high 30s to 50s to a posttest mean in the 80s. The CI group, on the other hand, went from approximately the same starting point to posttest mean of approximately 50. These results were not unexpected since the TEC groups had been given the correct answers to the LAI tests after each pretest as an explicit part of TEC training, while the CI groups had not.

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APPENDIXES

TRAINING OBJECTIVES

HAND GRENADES

<u>Purpose and Scope</u>: To provide the soldier with the skills and knowledge required to identify individual hand grenades, know their capabilities and limitations, and how they can best be employed.

<u>Learning Objectives</u>:

1. Types and uses of hand grenades including: M33, M34, M56, M57, M59, M18, AN-M8, M25A1 or M25A2, M7A2 or M7A3, AN-M14TH3, and MK3A2.

2. Maintenance of the hand grenade: Identify the unsafe or defective hand grenades and state the corrective action to be taken.

3. Engaging the enemy with hand grenades, including:

    a. Holding the hand grenade,

    b. Arming of the fragmentation hand grenade,

    c. Arming of the M25 riot control hand grenade,

    d. Throwing positions, and

    e. Carrying the hand grenade.

M72A2 LAW

<u>Purpose and Scope</u>: To provide the soldier with the skills and knowledge required to conduct a safety and serviceability check on the M72A2 LAW, place the M72A2 LAW into operation, perform misfire procedures, and take the M72A2 LAW out of operation.

<u>Learning Objectives</u>:

1. Serviceability of the M72A2 Light Antitank Weapon.

    a. Identify parts that determine serviceability of the LAW.

    b. Determine the serviceability of a LAW.

2. Place the LAW into operation:

    Identify the correct procedure for placing the LAW into operation.

3. Firing positions and engaging targets with the LAW.

    a. Vulnerability of armored vehicles.

    b. Identify the five firing positions and advantages/disadvantages of each.

    c. Terrain positions from which to engage a target.

    d. Use the stadia lines to determine the range of a target.

    e. Sight picture for a stationary target.

4. How to destroy the launcher after firing.

5. Apply immediate action to correct malfunctions of a LAW.

6. Restore LAW to carrying configuration.

M16A1 RIFLE

<u>Purpose and Scope</u>: The purpose of this lesson is to provide the soldier with skills and knowledges required to perform the following procedures: clearing, disassembly and assembly; cleaning and lubricating; functioning checks; and correcting malfunctions of the M16A1 rifle.

<u>Learning Objectives</u>:

1. Disassemble and assemble an M16A1 rifle (will be referred to here as "rifle").

    a. Clear the rifle prior to disassembly.

    b. Disassemble the rifle until field stripped.

2. Inspect and service the rifle.

    a. Inspect parts of the rifle for cleanliness and serviceability.

    b. Know critical parts of the rifle to be cleaned and what lubricant to use.

3. Assemble the rifle.

4. Load the magazine and the rifle properly.

5. Perform a functioning check on the rifle.

6. Apply immediate action to reduce a stoppage of a rifle.

7. Correct malfunctions of a rifle.

8. Disassemble and assemble the M16A1 magazine.

81MM MORTAR FDC

Purpose and Scope: To provide the soldier (11C MOS) with the skills and knowledges to set up the M16 plotting board as an observed firing chart, receive and record calls for fire, complete the Computer's Record (DA Form 2399), conduct a registration mission, compute sheaf adjustments, and plot targets on the M16 plotting board.

Learning Objectives:

1. Description and use of the M16 plotting board.

2. The observed firing chart: Registration mission.

    a. Receive and record an FO's Call for Fire (Registration) in the DA Form 2399, "Computer's Record."

    b. Determine mounting azimuth.

    c. Formulate and enter FDC order in the Computer's Record.

    d. Superimpose deflection scale on M16 plotting board.

    e. Determine and enter chart deflection on Computer's Record.

    f. Plot the initial round of an RP mission using the M16 plotting board as an Observed Chart.

    g. Complete the Initial Fire Command section of the Computer's Record.

    h. Determine and enter the charge and elevation on the Computer's Record.

    i. Determine and enter the angle T on the Computer's Record.

    j. Formulate message to the observer.

    k. Enter the number of rounds expended on the Computer's Record.

    l. Receive, record and plot FO's corrections.

    m. Formulate and enter subsequent commands on the Computer's Record.

    n. Record number of rounds expended on the Computer's Record.

3. Special Corrections.

    a. Enter FO's request for section left or right on the Computer's Record.

    b. Enter the FO's sheaf correction on the Computer's Record.

    c. Determine the number of mils correction per mortar to parallel the sheaf, using the mil relation formula.

    d. Enter subsequent commands for sheaf correction in Computer's Record.

    e. Enter FDC's command to refer and realine aiming posts on the Computer's Record.

SURVEYED FIRING CHARTS

Purpose and Scope: The purpose of this lesson is to provide the soldier (13E MOS) assigned to or anticipating assignment to a fire direction center the skills and knowledges required to construct and maintain a surveyed firing chart. These skills are needed by the HCO.

Learning Objectives:

1. Construct a surveyed firing chart.

    a. Label the grid sheet.

    b. Label RDP with deflection scale.

    c. Plot and label surveyed locations (batteries, targets, observation points, radars, etc.).

    d. Compute, construct and label primary and supplementary deflection indices for appropriate position.

2. Plot targets in calls for fire, determine chart data (range, deflection, angle T) and continue for subsequent observer adjustments until end of mission.

3. Properly label targets.

4. Determine chart data for subsequent calls for fire using:

    a. Polar Plot method.

    b. Shift from a known point.

APPENDIX B   **PERFORMANCE TEST DESCRIPTIONS**

HAND GRENADE PERFORMANCE TEST

The hand grenade performance test was written from the performance objectives as described in the Technical Supplement. The test comprised sections on Selection of Grenades (10 points), Inspection and Servicing (12 points), and Identifying the Parts of a Riot Control Grenade and Preparing to Throw (8 points). In the Inspection section, one item required a grenade fiber container. This item was omitted from the Active Army scoring because the container was not obtained until after testing at the first post. Although this test required some manual skill, it was primarily informational and cognitive.

LAW PERFORMANCE TEST

Three sections of the LAW performance test were taken from the Expert Infantryman Badge (EIB) test (AR 672-12) updated using the performance objectives. These sections tested Placing the LAW into Operation (6 points), Misfire Procedures (9 points), and Taking the LAW out of Operation (6 points). The soldier was required to demonstrate three firing positions (3 points) selected from positions described in materials prepared by the Infantry School for a prior research project. The final item was a target selection item from the basic combat training SMART book (TRADOC Pamphlet 600-4, 30 June 1973) (1 point). All except the last item of this test were mechanical demonstrations.

M16A1 RIFLE PERFORMANCE TEST

Content from three sources was combined to form the M16A1 Rifle performance test: the EIB test, SMART book (TRADOC Pamphlet 600-4), and current performance objectives. The final test included the same sections as the SMART book M16A1 Rifle test, except the section on "Removing Water." The sections of the EIB test which were not included in the final test were "Disassembly of the Bolt Carrier Group" and "Firing Positions." The content of all test sections was checked against the updated performance objectives before inclusion.

While knowledge of lubricants and other rifle information was required, the test was predominantly mechanical. The test sections contained the following number of points: Clearing, 8; Field Stripping, 17; Cleaning and Lubricating the Bore, 7; Cleaning and Lubricating the Bolt Carrier Key, 3; Assembly, 16; Function Check, 11; and Immediate action, 6. In the function check, 4 items on the AUTO position had to be omitted from the test in the National Guard because the selector could not be placed in that position.

81MM MORTAR FDC PERFORMANCE TEST

The Mortar FDC performance test was written from the performance objectives. In this test, the soldier used the M16 plotting board as an observed firing chart and completed the Computer's Record (DA Form 2399) for a registration mission using the pivot point method. The test sections and number of items were Record the Call for Fire (5), Determine Mounting Azimuth (3), Construct Deflection Scale (3), Determine Initial Fire Command (11), Subsequent Commands (33), and Sheaf Adjustment (2). The two items on Sheaf Adjustment were omitted from the test in the National Guard because that topic was not trained.

SURVEYED FIRING CHART PERFORMANCE TEST

This test was a revised version from the SMART book for the field artillery operations and intelligence assistant, MOS 13E20 (TRADOC Pamphlet 600-7). The soldier was required to perform the duties of the horizontal control operator given information and equipment needed to construct and operate a surveyed firing chart. The test sections and number of items were: Duties of the horizontal control operator (18), Target Location by Shift from a Known Point (6), Target Location by Polar Plot (3) and Determination of Chart Data (6).

CONVENTIONAL INSTRUCTION DESCRIPTIONS

HAND GRENADES

The hand grenade training at the first post was presented by an E4, assisted by another E4, in a 90 minute session. The content was based on FM 23-30, augmented by demonstration of replicas of some of the grenades. The last 20 minutes consisted of practical exercises in throwing positions. The other hand grenade class was a two-hour lecture by an officer (O2). It was based on FM 23-30, and included demonstration of dummy grenades.

LAW

In each instance the LAW training was presented by an E7 in a two-hour class. Actual expended LAWs were used for demonstrations and for individual practice of firing positions during a 15-minute drill. At one post the instructor was assisted by an E3.

M16A1 RIFLE

The M16 Rifle training was accompanied by individual practice on the rifle in all three battalions participating in the rifle research. In one battalion an E6 assisted by an E4 gave a one hour class. (On a prior date, an analogous class was interrupted by an IG inspection. The degree of disruption warranted conducting a new class for the research. The results and descriptions in this report refer to the repeated class given to a new sample of soldiers.) In the second battalion an E5 gave a 3 hour class, and in the third battalion an E3, assisted by another E3, gave a class lasting approximately two hours.

MORTAR FDC

The 81mm Mortar FDC classes lasted between 4 and 4.5 hours in each instance. The students had practical exercises on the relevant materials (M16 plotting boards, DA Form 2399, etc.) although not every man had access to a set of practice materials that was complete and functional. In one class, the instruction was shared by an E6 and an E5. In the other class, an officer (O1) presented the instruction, assisted by two enlisted men (E7 and E6). The latter class also had the benefit of an oversized M16 plotting board as a training aid.

SURVEYED FIRING CHARTS

Each class on surveyed firing charts lasted approximately six hours, including practical exercises. Substantial amounts of individual practice material were required (range deflection protractors, grid sheets,

plotting and coordinate scales, and many other items). One of the classes was taught by an O3, assisted by an E7. The instruction at the other post was presented by an E7.

Table C-1

ACTIVE ARMY PRIMARY MOS DISTRIBUTION

Lesson Category	Training Group	Number of Men by MOS					
		11B	11C	11D	13B	13E	Other MOS
Hand	TEC	12	1	0	0	0	0
Grenades	CI	14	1	0	0	0	0
	BL	18	2	0	0	0	0
LAW	TEC	18	0	0	0	0	0
	CI	12	1	1	0	0	2
	BL	12	3	2	0	0	2
M16A1	TEC	19	0	0	0	0	7
Rifle	CI	8	1	0	0	0	13
	BL	18	0	0	0	0	8
Mortar	TEC	5	12	0	0	0	0
FDC	CI	5	13	0	0	0	0
	BL	0	16	0	0	0	0
Surveyed	TEC	0	0	0	0	21	0
Firing	CI	0	0	0	1	19	0
Charts	BL	0	0	0	5	13	0

Table C-2

ACTIVE ARMY PAY GRADE DISTRIBUTION

Lesson Category	Training Group	Number of Men in Pay Grade					
		E1	E2	E3	E4	E5	E6
Hand	TEC	0	2	5	5	1	0
Grenades	CI	2	9	0	4	0	0
	BL	0	8	4	8	0	0
LAW	TEC	0	5	6	6	0	1
	CI	1	6	9	0	0	0
	BL	0	8	3	8	0	0
M16A1	TEC	0	2	7	15	2	0
Rifle	CI	1	4	5	11	1	0
	BL	2	11	7	3	3	0
Mortar	TEC	0	2	5	6	4	0
FDC	CI	0	7	5	5	1	0
	BL	1	6	5	3	1	0
Surveyed	TEC	0	4	9	7	1	0
Firing	CI	0	3	7	10	0	0
Charts	BL	0	4	7	4	3	0

Table C-3

ACTIVE ARMY TIME IN SERVICE DISTRIBUTION

Lesson Category	Training Group	Number of Men by Time in Service				
		1 yr or less	1-2 yrs	2-3 yrs	3-4 yrs	4 yrs +
Hand	TEC	4	4	3	0	2
Grenades	CI	8	3	4	0	0
	BL	7	11	1	0	1
LAW	TEC	7	4	3	2	2
	CI	9	5	2	0	0
	BL	6	9	2	0	2
M16A1	TEC	1	12	8	3	2
Rifle	CI	8	7	4	1	2
	BL	14	5	3	1	3
Mortar	TEC	4	5	6	0	2
FDC	CI	7	10	0	0	1
	BL	6	6	3	0	1
Surveyed	TEC	10	7	2	1	1
Firing	CI	4	13	3	0	0
Charts	BL	3	11	3	0	1

Table C-4

ACTIVE ARMY PREVIOUS TRAINING DISTRIBUTION

Lesson Category	Training Group	Previous Training [a]				
		No Training	BCT	BCT+AIT	Other Than BCT+AIT	Other + BCT+AIT
Hand Grenades	TEC	0	0	13	0	0
	CI	1	0	14	0	0
	BL	0	3	16	1	0
LAW	TEC	9	7	2	0	0
	CI	0	0	15	0	1
	BL	1	1	17	0	0
M16A1 Rifle	TEC	0	7	19	0	0
	CI	0	12	10	0	0
	BL	0	6	18	0	2
Mortar FDC	TEC	1	0	13	3	0
	CI	4	0	13	1	0
	BL	0	0	16	0	0
Surveyed Firing Charts	TEC	0	0	15	0	6
	CI	0	0	5	2	13
	BL	0	0	12	4	2

[a] Previous Training on the topic in the lesson category

Table C-5

ACTIVE ARMY LAI PRETEST SCORE MEANS AND STANDARD DEVIATIONS

Lesson Category		Training Groups			F	df
		TEC	CI	BL		
Hand Grenades	Mean	13.38	12.20	14.75	2.39	2, 45
	SD	3.43	4.09	2.86		
LAW	Mean	28.11	28.00	25.58	0.85	2, 50
	SD	7.57	6.70	5.53		
M16A1 Rifle	Mean	27.85	24.36	24.85	1.86	2, 71
	SD	6.48	6.49	7.62		
Mortar FDC [a]	Mean	14.71	11.39	14.19	3.82*	2, 48
	SD	3.08	4.84	3.19		
Surveyed Firing Charts	Mean	9.62	10.00	9.50	0.03	2, 56
	SD	4.77	6.52	7.52		

[a] Lesson No. 010-071-8601 pretest only

* $p < .05$

Table C-6

ACTIVE ARMY GENERAL TECHNICAL APTITUDE AREA SCORE
MEANS AND STANDARD DEVIATIONS

Lesson Category		Training Groups			F	df
		TEC	CI	BL		
Hand Grenades	Mean	101.69	105.40	104.70	0.19	2, 45
	SD	18.46	14.69	17.51		
LAW	Mean	95.11	106.06	101.63	2.42	2, 50
	SD	11.74	13.16	17.96		
M16A1 Rifle	Mean	101.61	103.41	98.58	0.74	2, 71
	SD	12.24	16.97	12.93		
Mortar FDC	Mean	114.12	102.11	115.69	4.10*	2, 48
	SD	14.99	12.61	18.13		
Surveyed Firing Charts	Mean	115.00	115.85	117.94	0.36	2, 56
	SD	10.94	12.10	9.57		

* $p < .05$

Table C-7

ANALYSIS OF VARIANCE OF ACTIVE ARMY HAND GRENADE, LAW, AND MORTAR FDC PERFORMANCE TEST SCORES

Lesson Category	Source	Sum of Squares	df	Mean Square	F
Hand Grenades	Between Training Groups	718.29	2	359.14	13.85***
	Within Groups	1166.96	45	25.93	
	Total	1885.25	47		
LAW	Between Training Groups	127.21	2	63.60	3.71*
	Within Groups	857.10	50	17.14	
	Total	984.30	52		
Mortar FDC	Between Training Groups	5748.30	2	2874.15	5.77**
	Within Groups	23901.85	48	497.96	
	Total	29650.16	50		

*** $p < .001$
** $p < .01$
* $p < .05$

Table C-8

ANALYSIS OF VARIANCE OF ACTIVE ARMY
M16A1 RIFLE PERFORMANCE TEST SCORES

Source	Sum of Squares	df	Mean Square	F
Battalions	2145.67	2	1072.84	9.21***
Training Groups	397.23	2	198.61	1.71
Interaction	741.81	4	185.45	1.59
Within Cells	7568.69	65	116.44	
Total	10853.40	73		

*** $p < .001$

Table C-9

ANALYSIS OF VARIANCE OF SURVEYED FIRING CHART
PERFORMANCE TEST SCORES

Source	Sum of Squares	df	Mean Square	F
Posts	481.22	1	481.22	8.31**
Training Groups	395.45	2	197.72	3.41*
Interaction	290.15	2	145.07	2.50
Within Cells	3069.88	53	57.92	
Total	4236.70	58		

** $p < .01$
* $p < .05$

Table C-10

ACTIVE ARMY CORRELATIONS AMONG PERFORMANCE TEST, LAI PRETEST, AND GT SCORES

Lesson Category	Training Group	Performance and LAI Pretest	Performance and GT	LAI Pretest and GT	N
Hand Grenades	TEC	.62*	-.02	.40	13
	CI	.83*	.61*	.69*	15
	BL	.41	.24	.60*	20
	Combined:	.47*	.16	.52*	48
LAW	TEC	.32	.06	.39	18
	CI	.30	.54*	.36	16
	BL	.57*	.44*	.72*	19
	Combined:	.42	.30*	.44*	53
M16A1 Rifle	TEC	.15	.02	.48*	26
	CI	.51*	.24	.46*	22
	BL	.37	.43*	.21	26
	Combined:	.36*	.21	.36*	74
Mortar FDC	TEC	.76*	-.13	.26	17
	CI	.63*	.27	.21	18
	BL	.48	.71*	.66*	16
	Combined:	.66*	.26	.44*	51
Surveyed Firing Charts	TEC	.51*	.02	.13	21
	CI	.77*	.11	.35	20
	BL	.44	.27	.48*	18
	Combined:	.56*	.09	.32*	59

* p < .05

Table C-11

ACTIVE ARMY PERCENT CORRECT ON
LAI PRETESTS AND POSTTESTS

Lesson Category	Training Group	Percent Correct	
		LAI Pretest	LAI Posttest
Hand Grenades	TEC	46%	88%
	CI	42%	54%
LAW	TEC	43%	83%
	CI	44%	56%
M16A1 Rifle	TEC	44%	78%
	CI	38%	49%
Mortar FDC [a]	TEC	73%	94%
	CI	57%	72%
Surveyed Firing Charts	TEC	42%	67%
	CI	43%	57%

[a] Lesson No. 010-071-6601 tests only

CONVENTIONAL INSTRUCTION DESCRIPTIONS

HAND GRENADES

Training was conducted by an E5 who possessed some experience in training small classes. He was assisted by an E4. Total training time was about 3 hours. Training aids used were less than adequate: an obsolete film was shown and dummy grenades were not available. Major topics covered were: (1) Types of Grenades, (2) Uses of Particular Grenades, and (3) Throwing Positions. Initial interest by the trainees was high but waned considerably when the instructor did not satisfactorily answer questions. Interest was somewhat increased by a class discussion of what grenades should be used in various situations and by a demonstration of throwing positions.

LAW

Training was conducted by an O2 who had teaching experience on this topic. Training time spent was about 1 1/2 hours. One training aid was used, an expended M72 LAW. Working from a detailed outline, the following major topics were covered: (1) Descriptive Data, (2) Mechanical Operation, (3) Misfire Procedures, (4) Aiming and Firing. Trainee interest was sustained at a moderately high level throughout the session.

M16A1 RIFLE

Training was conducted by an E5 with assistance by another E5. Training lasted about 2 1/4 hours. View-graphs were used to show parts of the M16A1 rifle. Each trainee had his own M16A1 rifle. Major topics covered were: (1) Disassembly and Assembly, (2) Inspection and Maintenance, and (3) Correcting Common Malfunctions. Trainee interest appeared low for the first two topics because of their review nature. The last topic generated high interest and active trainee participation.

MORTAR FDC

Training was conducted by an E7 who was an experienced instructor on this topic. Training time including breaks (but excluding lunch) lasted about 5 1/2 hours. One training aid was used, an oversized M16 plotting board. Half of the group lacked plotting boards, the major piece of equipment for the computer. Major topics covered were: (1) Familiarization with M16 Plotting Board, (2) Plotting of Mortar Rounds, (3) Completing the Computer's Record, DA Form 2399, and (4) Use of Firing Tables. The lecture style of presentation and the deficient equipment produced low trainee interest.

Table D-1

NATIONAL GUARD PRIMARY MOS DISTRIBUTION

Lesson Category	Group	Number of Men by MOS		
		11B	11C	Other
Hand Grenades	TEC	10	4	6
	CI	14	6	0
	BL	11	5	3
LAW	TEC	13	3	3
	CI	18	1	1
	BL	15	2	3
M16A1 Rifle	TEC	3	3	9
	CI	9	3	3
	BL	7	2	4
Mortar FDC	TEC	1	17	0
	CI	1	16	0
	BL	0	18	1

Table D-2

NATIONAL GUARD PAY GRADE DISTRIBUTION

Lesson Category	Group	Number of Men in Pay Grade			
		E1-E3	E4	E5	E6-E9
Hand Grenades	TEC	4	11	3	2
	CI	6	9	3	2
	BL	6	7	4	2
LAW	TEC	6	7	4	2
	CI	5	8	4	3
	BL	6	9	3	2
M16A1 Rifle	TEC	1	8	4	2
	CI	0	8	7	0
	BL	0	7	2	4
Mortar FDC	TEC	3	7	6	2
	CI	5	6	5	1
	BL	6	6	6	1

Table D-3

NATIONAL GUARD TIME IN SERVICE DISTRIBUTION

Lesson Category	Group	Number of Men by Time in Service					
		0-2 yrs	2-2½ yrs	2½-3 yrs	3-3½ yrs	3½-4 yrs	4+ yrs
Hand Grenades	TEC	2	4	0	1	0	13
	CI	5	1	0	1	2	11
	BL	5	1	1	0	1	11
LAW	TEC	2	2	4	1	2	8
	CI	5	1	3	0	2	9
	BL	4	1	4	1	2	8
M16A1 Rifle	TEC	0	1	3	0	2	9
	CI	1	1	3	1	4	5
	BL	0	0	1	1	1	10
Mortar FDC	TEC	0	0	1	1	5	11
	CI	0	0	1	3	3	10
	BL	3	2	1	1	1	11

Table D-4

NATIONAL GUARD PREVIOUS TRAINING DISTRIBUTION [a]

Lesson Category	Group	No Training	BCT Only	AIT and BCT	Other Training
Hand Grenades	TEC	9	0	11	0
	CI	3	4	13	0
	BL	6	0	13	0
LAW	TEC	4	5	10	0
	CI	7	1	12	0
	BL	6	0	14	0
M16A1 Rifle	TEC	0	6	9	0
	CI	0	8	7	0
	BL	0	4	8	1
Mortar FDC	TEC	0	1	14	3
	CI	0	0	15	2
	BL	0	0	13	6

[a] Previous training on the topic in the lesson category

Table D-5

NATIONAL GUARD LAI PRETEST SCORE
MEANS AND STANDARD DEVIATIONS

Lesson Category		Training Groups			F	df
		TEC	CI	BL		
Hand Grenades	Mean	11.25	10.45	9.84	0.62	2, 56
	SD	3.86	4.25	3.45		
LAW	Mean	25.16	26.35	28.65	1.20	2, 56
	SD	6.14	8.70	6.30		
M16A1 Rifle	Mean	30.73	28.20	24.31	3.07	2, 40
	SD	5.72	6.32	7.83		
Mortar FDC [a]	Mean	10.44	8.35	11.58	2.48	2, 51
	SD	4.45	4.32	4.38		

[a] Lesson No. 010-071-6601 pretest only

Table D-6

NATIONAL GUARD GENERAL TECHNICAL APTITUDE AREA SCORE MEANS AND STANDARD DEVIATIONS

Lesson Category		Training Groups			F	df
		TEC	CI	BL		
Hand Grenades	Mean	107.85	107.30	106.79	0.02	2, 56
	SD	14.64	13.84	14.95		
LAW	Mean	112.00	111.00	108.75	0.27	2, 56
	SD	15.47	15.46	11.69		
M16A1 Rifle	Mean	108.73	118.80	116.00	3.45*	2, 40
	SD	8.98	13.00	8.45		
Mortar FDC	Mean	117.61	109.18	114.42	0.76	2, 51
	SD	15.86	17.60	25.86		

* $p < .05$

Table D-7

ANALYSIS OF VARIANCE OF NATIONAL GUARD HAND GRENADE, LAW, AND MORTAR FDC PERFORMANCE TEST SCORES

Lesson Category	Source	Sum of Squares	df	Mean Square	F
Hand Grenades	Between Training Groups	991.57	2	495.79	22.44***
	Within Groups	1237.17	56	22.09	
	Total	2228.75	58		
LAW	Between Training Groups	308.86	2	154.43	7.14**
	Within Groups	1211.88	56	21.64	
	Total	1520.75	58		
Mortar FDC	Between Training Groups	2432.41	2	1216.20	3.61*
	Within Groups	17160.85	51	336.49	
	Total	19593.26	53		

*** $p < .001$
** $p < .01$
* $p < .05$

Table D-8

ANALYSIS OF COVARIANCE OF NATIONAL GUARD
M16A1 RIFLE PERFORMANCE TEST SCORES

Source	Sum of Squares	df	Mean Square	F
Equality of Adj. Cell Means [a]	2062.81	2	1031.40	10.66***
Zero Slope	252.56	2	126.28	1.31
Error	3677.03	38	96.76	
Equality of Slopes	137.35	4	34.34	0.33
Error	3539.68	34	104.12	

[a] Means adjusted for LAI pretest and GT scores

*** $p < .001$

Table D-9

NATIONAL GUARD CORRELATIONS AMONG PERFORMANCE TEST, LAI PRETEST, AND GT SCORES

Lesson Category	Training Group	Performance and LAI Pretest	Performance and GT	LAI Pretest and GT	N
Hand Grenades	TEC	.05	.58*	.40	20
	CI	.73*	.31	.21	20
	BL	.58*	.36	.63*	19
	Combined:	.46*	.32*	.40*	59
LAW	TEC	.25	.13	.06	19
	CI	.27	.15	.44	20
	BL	.08	.18	.03	20
	Combined:	.09	.18	.20	59
M16A1 Rifle	TEC	.14	.27	.23	15
	CI	.45	.37	.36	15
	BL	.04	-.01	.46	13
	Combined:	.36*	.08	.21	43
Mortar FDC	TEC	.48*	.26	.31	18
	CI	.32	.49*	.43	17
	BL	.42	.31	.41	19
	Combined:	.41*	.32*	.36*	54

* $p < .05$

Table D-10

NATIONAL GUARD PERCENT CORRECT ON LAI
PRETESTS AND POSTTESTS

Lesson Category	Training Group	Percent Correct	
		LAI Pretest	LAI Posttest
Hand Grenades	TEC	39%	89%
	CI	36%	37%
LAW	TEC	40%	83%
	CI	42%	51%
M16A1 Rifle	TEC	48%	82%
	CI	44%	57%
Mortar FDC [a]	TEC	52%	83%
	CI	42%	69%

[a] Lesson No. 010-071-6601 test only

DISTRIBUTION

ARI Distribution List

4 OASD (M&RA)
2 HQDA (DAMI-CSZ)
1 HQDA (DAPE-PBR
1 HQDA (DAMA-AR)
1 HQDA (DAPE-HRE-PO)
1 HQDA (SGRD-ID)
1 HQDA (DAMI-DOT-C)
1 HQDA (DAPC-PMZ-A)
1 HQDA (DACH-PPZ-A)
1 HQDA (DAPE-HRE)
1 HQDA (DAPE-MPO-C)
1 HQDA (DAPE-DW)
1 HQDA (DAPE-HRL)
1 HQDA (DAPE-CPS)
1 HQDA (DAFD-MFA)
1 HQDA (DARD-ARS-P)
1 HQDA (DAPC-PAS-A)
1 HQDA (DUSA-OR)
1 HQDA (DAMO-RQR)
1 HQDA (DASG)
1 HQDA (DA10-PI)
1 Chief, Consult Div (DA-OTSG), Adelphi, MD
1 Mil Asst. Hum Res, ODDR&E, OAD (E&LS)
1 HQ USARAL, APO Seattle, ATTN: ARAGP-R
1 HQ First Army, ATTN: AFKA-OI-TI
2 HQ Fifth Army, Ft Sam Houston
1 Dir, Army Stf Studies Ofc, ATTN: OAVCSA (DSP)
1 Ofc Chief of Stf, Studies Ofc
1 DCSPER, ATTN: CPS/OCP
1 The Army Lib, Pentagon, ATTN: RSB Chief
1 The Army Lib, Pentagon, ATTN: ANRAL
1 Ofc, Asst Sect of the Army (R&D)
1 Tech Support Ofc, OJCS
1 USASA, Arlington, ATTN: IARD-T
1 USA Rsch Ofc, Durham, ATTN: Life Sciences Dir
2 USARIEM, Natick, ATTN: SGRD-UE-CA
1 USATTC, Ft Clayton, ATTN: STETC-MO-A
1 USAIMA, Ft Bragg, ATTN: ATSU-CTD-OM
1 USAIMA, Ft Bragg, ATTN: Marquat Lib
1 US WAC Ctr & Sch, Ft McClellan, ATTN: Lib
1 US WAC Ctr & Sch, Ft McClellan, ATTN: Tng Dir
1 USA Quartermaster Sch, Ft Lee, ATTN: ATSM-TE
1 Intelligence Material Dev Ofc, EWL, Ft Holabird
1 USA SE Signal Sch, Ft Gordon, ATTN: ATSO-EA
1 USA Chaplain Ctr & Sch, Ft Hamilton, ATTN: ATSC-TE-RD
1 USATSCH, Ft Eustis, ATTN: Educ Advisor
1 USA War College, Carlisle Barracks, ATTN: Lib
2 WRAIR, Neuropsychiatry Div
1 DLI, SDA, Monterey
1 USA Concept Anal Agcy, Bethesda, ATTN: MOCA-WGC
1 USA Concept Anal Agcy, Bethesda, ATTN: MOCA-MR
1 USA Concept Anal Agcy, Bethesda, ATTN: MOCA-JF
1 USA Artic Test Ctr, APO Seattle, ATTN: STEAC-MO-ASL
1 USA Artic Test Ctr, APO Seattle, ATTN: AMSTE-PL-TS
1 USA Armament Cmd, Redstone Arsenal, ATTN: ATSK-TEM
1 USA Armament Cmd, Rock Island, ATTN: AMSAR-TDC
1 FAA-NAFEC, Atlantic City, ATTN: Library
1 FAA-NAFEC, Atlantic City, ATTN: Hum Engr Br
1 FAA Aeronautical Ctr, Oklahoma City, ATTN: AAC-44D
2 USA Fld Arty Sch, Ft Sill, ATTN: Library
1 USA Armor Sch, Ft Knox, ATTN: Library
1 USA Armor Sch, Ft Knox, ATTN: ATSB-DI-E
1 USA Armor Sch, Ft Knox, ATTN: ATSB-DT-TP
1 USA Armor Sch, Ft Knox, ATTN: ATSB-CD-AD

2 HQUSACDEC, Ft Ord, ATTN: Library
1 HQUSACDEC, Ft Ord, ATTN: ATEC-EX-E-Hum Factors
2 USAEEC, Ft Benjamin Harrison, ATTN: Library
1 USAPACDC, Ft Benjamin Harrison, ATTN: ATCP-HR
1 USA Comm-Elect Sch, Ft Monmouth, ATTN: ATSN-EA
1 USAEC, Ft Monmouth, ATTN: AMSEL-CT-HDP
1 USAEC, Ft Monmouth, ATTN: AMSEL-PA-P
1 USAEC, Ft Monmouth, ATTN: AMSEL-SI-CB
1 USAEC, Ft Monmouth, ATTN: C, Facl Dev Br
1 USA Materials Sys Anal Agcy, Aberdeen, ATTN: AMXSY-P
1 Edgewood Arsenal, Aberdeen, ATTN: SAREA-BL-H
1 USA Ord Ctr & Sch, Aberdeen, ATTN: ATSL-TEM-C
2 USA Hum Engr Lab, Aberdeen, ATTN: Library/Dir
1 USA Combat Arms Tng Bd, Ft Benning, ATTN: Ad Supervisor
1 USA Infantry Hum Rsch Unit, Ft Benning, ATTN: Chief
1 USA Infantry Bd, Ft Benning, ATTN: STEBC-TE-T
1 USASMA, Ft Bliss, ATTN: ATSS-LRC
1 USA Air Def Sch, Ft Bliss, ATTN: ATSA-CTD-ME
1 USA Air Def Sch, Ft Bliss, ATTN: Tech Lib
1 USA Air Def Bd, Ft Bliss, ATTN: FILES
1 USA Air Def Bd, Ft Bliss, ATTN: STEBD-PO
1 USA Cmd & General Stf College, Ft Leavenworth, ATTN: Lib
1 USA Cmd & General Stf College, Ft Leavenworth, ATTN: ATSW-SE-L
1 USA Cmd & General Stf College, Ft Leavenworth, ATTN: Ed Advisor
1 USA Combined Arms Cmbt Dev Act, Ft Leavenworth, ATTN: DepCdr
1 USA Combined Arms Cmbt Dev Act, Ft Leavenworth, ATTN: CCS
1 USA Combined Arms Cmbt Dev Act, Ft Leavenworth, ATTN: ATCASA
1 USA Combined Arms Cmbt Dev Act, Ft Leavenworth, ATTN: ATCACO-E
1 USA Combined Arms Cmbt Dev Act, Ft Leavenworth, ATTN: ATCACC-CI
1 USAECOM, Night Vision Lab, Ft Belvoir, ATTN: AMSEL-NV-SD
3 USA Computer Sys Cmd, Ft Belvoir, ATTN: Tech Library
1 USAMERDC, Ft Belvoir, ATTN: STSFB-DQ
1 USA Eng Sch, Ft Belvoir, ATTN: Library
1 USA Topographic Lab, Ft Belvoir, ATTN: ETL-TD-S
1 USA Topographic Lab, Ft Belvoir, ATTN: STINFO Center
1 USA Topographic Lab, Ft Belvoir, ATTN: ETL-GSL
1 USA Intelligence Ctr & Sch, Ft Huachuca, ATTN: CTD-MS
1 USA Intelligence Ctr & Sch, Ft Huachuca, ATTN: ATS-CTD-MS
1 USA Intelligence Ctr & Sch, Ft Huachuca, ATTN: ATSI-TE
1 USA Intelligence Ctr & Sch, Ft Huachuca, ATTN: ATSI-TEX-GS
1 USA Intelligence Ctr & Sch, Ft Huachuca, ATTN: ATSI-CTS-OR
1 USA Intelligence Ctr & Sch, Ft Huachuca, ATTN: ATSI-CTD-DT
1 USA Intelligence Ctr & Sch, Ft Huachuca, ATTN: ATSI-CTD-CS
1 USA Intelligence Ctr & Sch, Ft Huachuca, ATTN: DAS/SRD
1 USA Intelligence Ctr & Sch, Ft Huachuca, ATTN: ATSI-TEM
1 USA Intelligence Ctr & Sch, Ft Huachuca, ATTN: Library
1 CDR, HQ Ft Huachuca, ATTN: Tech Ref Div
2 CDR, USA Electronic Prvg Grd, ATTN: STEEP-MT-S
1 CDR, Project MASSTER, ATTN: Tech Info Center
1 Hq MASSTER, USATRADOC, LNO
1 Research Institute, HQ MASSTER, Ft Hood
1 USA Recruiting Cmd, Ft Sherdian, ATTN: USARCPM-P
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2 USCG Academy, New London, ATTN: Admission
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1 USCG, Psychol Res Br, DC, ATTN: GP 1/62
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